PROJECT MANUAL
VOLUME 1 OF 3

New Academic Laboratory Building
Southern Connecticut State University

485 Fitch Street
New Haven, CT

Project No.: BI-RS-283 – CMr

State Of Connecticut
Department Of Construction Services
Donald DeFronzo – Acting Commissioner

Prepared By:
Centerbrook Architects and Planners
67 Main Street
Centerbrook, CT
06409

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Southern Connecticut State University

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Seals & Signatures		Seals & Signatures	
	CENTERBROOK ARCHITECTS *Architect*		*(Print Consultant Name)*
	BVH INTEGRATED SERVICES *M/E/P/FP/IT/ Security Engineer*		*(Print Consultant Name)*
	GILSANZ MURRAY STEFICEK *Structural Engineer*		*(Print Consultant Name)*
	MILONE & MACBROOM *Civil Engineer*		*(Print Consultant Name)*
	RICHTER AND CEGAN *Landscape Architect*		*(Print Consultant Name)*

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Refer to “Instructions to Bidders and Bid Packages” issued by CMr

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AVAILABLE INFORMATION

Document Name

REPORT ON FINAL GEOTECHNICAL ENGINEERING RECOMMENDATIONS AND PRELIMINARY PRECHARACTERIZATION INVESTIGATION
(January 12, 2011) *
** The full report is available in digital form upon request.*

REPORT ON FINAL PRECHARACTERIZATION INVESTIGATION
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*** The full report is available in digital form upon request.*

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Construction Documents and general provisions of the CMR Agreement Between Owner and Construction Manager and the Guaranteed Maximum Price (GMP) Amendment, including Division 00 General Conditions of the Contract for Construction – CMR and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 WORK COVERED BY CONTRACT DOCUMENTS

A. Project Number: BI-RS-283.

B. Project Title: New Academic and Laboratory Building.

C. Project Location: The Southern Connecticut State University, 485 Fitch Street, New Haven, Connecticut.

D. The Project Description: The Work includes but is not limited to the following and as Work shown on drawings and specified on specification sections.

1. Construction of a building of approximately 98,478 gross square feet.
2. The building is new and shall be constructed of materials that include but are not limited to the following: The structure shall consist of cast-in-place concrete and steel frame. Exterior wall construction shall consist of brick with CMU backup and glass curtain wall. Roof construction shall consist of steel frame and composite concrete and metal deck. Foundations shall consist of cast-in-place concrete. The new building will provide a new underground passage and a third floor passage connections to Jennings Hall. A new Science Quad will be provided between these buildings, replacing an existing parking lot.
3. The authority having jurisdiction for this Project is Connecticut Department of Construction Services, Division of Fire and Building Services (DF&BS).
   a. Office of State Building Inspector (OSBI) for compliance with State Building Code.
   b. Office of State Fire Marshal (OSFM) for compliance with Connecticut State Fire Code.

E. Owner:

1. Owner's Name: The Owner is the Department of Construction Services (CTDCS), State of Connecticut.
2. CTDCS Project Manager Name: Robert Prentice.
   a. CTDCS Project Manager's Location: The Project manager is located in Room 460, at 165 Capitol Avenue, Hartford, CT, 06604.
   b. Phone: (860) 713-5830;
   d. Email(s): robert.prentice@ct.gov.
3. Authority: The CTDCS Project Manager is the only authorized representative for the Department of Construction Services Commissioner to act in matters involving revoking, altering, enlarging or relaxing any requirement of the contract documents.
   a. Related Section: Article 25, All Work Subject To Control Of The Commissioner, Division 00 General Conditions Of The Contract For Construction For Construction Manager At Risk (CMR).

F. Agency:

1. Agency Name: The Connecticut State (User) Agency is Southern Connecticut State University.
2. Agency Representative Name and Title: Robert Sheeley. The Agency Representative's Title is Associate Vice President of Facilities.

a. Agency Representative Location: The Agency Representative located in SCSU Office of Facilities, 615 Fitch Street, Hamden, CT 06514-4803.

b. Phone: (203) 392-6050;

c. Fax: (203) 392-6058;

d. Email(s): sheeleyr1@southernct.edu.

3. Authority: The Agency Representative has the administrative authority for the facility and or site where the work is being performed but does not have the authority to change the contract documents or direct the Construction Manager.

G. Architect and Engineer:

1. Architect's Name: The Architect representing the firm for this project is Jefferson Riley, Centerbrook Architects and Planners.

a. Architect's Location: The Architect is located at 67 Main Street, PO Box 955, Centerbrook, CT 06409.

b. Phone: (860) 767-0175;

c. Fax: (860) 767 8719;

d. Email(s): riley@centerbrook.com.

e. Project Manager: Reno Migani migani@centerbrook.com

2. The Architect and Engineer or their accredited representative is referred to in the Contract Documents as "Architect" or "Architects" or "Engineer" or "Engineers" or by pronouns which imply them. As information for the Construction Manager, the Architect's or Engineer's status is defined as follows:

a. The Architect and Engineer will not make interpretations or decisions directly to the ~~r~~ Construction Manager. All interpretations or decisions, unless stated otherwise, will be conveyed through the Owner's Representative to the Project Manager.

b. As the authorized representative of the Department of Construction Services Commissioner, the Architect and Engineer is responsible for review of shop drawings, materials, and equipment intended for the work, in accordance with the "General Conditions - CMR", and the "Supplementary Conditions."

3. Wherever the Architect or Engineer is mentioned in the documents in connection with an administrative function, it shall include the Owner's Representative in that function except for shop drawings.

4. Related Section: Article 25, Division 00 General Conditions Of The Contract For Construction For Construction Manager At Risk (CMR).

H. Owner's Representative (OR):

1. Owner's Representative Name: Stephen Burke, The Liro Group.

a. Owner's Representative Location: The Owner's Representative is located at 111 Broadway, Suite 501, New York, NY 10006.

b. Phone: (212)563-0280;

d. Email(s): burkes@liro.com.

2. Authority: As information to the Construction Manager, the Owner's Representative status is defined as follows:

a. The Owner's Representative is referred to in the Contract Documents as Owner's Representative or Construction Administrator (ACA) or by pronouns which imply it. All communications concerning the Project will be directed through the Owner's Representative or a designated representative(s).

b. The Owner's Representative is the Owner's Agent who will, among other thing's, monitor and analyze the Construction Manager's performance, scheduling and construction, process shop drawings, material, and equipment submittals, review and process periodic billings, review, analyze, and recommend cost changes.

5. Related Section: Article 26 "Authority of the Owner's Representative", Division 00, General Conditions of the Contract for Construction for Construction Manager at Risk (CMR).

J. Construction Manager (CMR):

1. Construction Manager's Name (CMR): FIP Construction

   a. Construction Manager's Firm's Location: The Construction Manager is located at

      308 Farmington Avenue, Farmington, Connecticut 06032

   b. Phone: 203-271-0356;

   c. Fax: 203-271-5073;

   d. Email(s): hardywg@fipconstruction.com

2. Authority: Construction Manager is under direct Contract with the Department of Construction Services, responsible for performing the Work under the Contract Documents. Whenever the words "Contractor" or "General Contractor" are used it shall be understood to mean Construction Manager.

3. Related Sections: Article 1 "Definitions" of Division 00, General Conditions of the Contract for Construction for Construction Manager at Risk (CMR). and Article 2, Construction Manager At Risk Responsibilities, 2.3, Construction Phase of Section 00 52 23 Standard Form of Agreement Between Owner and Construction Manager-At-Risk (CMR) For Guaranteed Maximum Price (GMP).

K. Work: The Work includes but is not limited to the following:

1 Site Construction, Landscaping, Site Utilities;

2 Cast-in-Place Concrete, Architectural Precast Concrete;

3 Masonry;

4 Structural Steel, Miscellaneous Metals;

5 Rough Carpentry, Architectural Woodwork, Laminate Clad Casework;

6 Waterproofing, Insulation, Sprayed-on Fireproofing, Firestopping, Roofing, Sheet metal, and Joint Sealants;

7 Doors and Frames, Aluminum Windows, Hardware, and Glazed Aluminum Curtain Wall;

8 Drywall, Floor Coverings, Acoustical Ceilings, and Painting;

9 Visual Display Boards, Toilet Compartments, Louvers and Vents, Wall Surface Protection Systems, Signage, Lockers, Fire Extinguishers, and Toilet Accessories;

10 Projection Screens, Laboratory Furnishings, Fume hoods, Fittings and Fixtures, and Equipment;

11 Louver Blinds and Floor Mats;

12 Elevators;

13 Plumbing, Fire Protection, HVAC, and Controls;

14 Electrical, Telecommunication, Security, and Fire Alarm Systems; and

15 Special Equipment.

L. The Construction Manager shall confirm and verify that subcontractors bids, in concert with CMR's own General Conditions responsibilities, will address and include in his bid, all items required in order to carry out the intent of the Work as described, shown and implied in the Contract Documents.

M. It shall be the Construction Manager's responsibility upon discovery to immediately notify the Owner's Representative, in writing, of errors, omissions, discrepancies, and instances of non-compliance with applicable codes and regulations within the documents, and of any work which will not fit or properly function if installed as indicated on the Contract Documents. Any additional costs arising from the Construction Manager's failure to provide such notification shall be borne by the Construction Manager.

N. The Work will be constructed under a Construction Manager-At-Risk (CMR) For Guaranteed Maximum Price (GMP contract.

1.3 WORK UNDER OTHER CONTRACTS: Not Applicable

1.4 FUTURE WORK:

A. Future Contract: Not applicable.

1.5 WORK SEQUENCE (PHASES):

A. Phases: Not applicable.

1.6 CONSTRUCTION MANAGER AT RISK USE OF PREMISES:

A. General: During the construction period the Construction Manager shall have full use of the newly constructed premises for construction operations, including use of the site. The Construction Manager's use of the premises is limited only by the Owner's right to perform work or to retain other Contractors on portions of the Project.

B. Use of the Site: Limit use of the premises to work in areas indicated. Confine operations to areas within contract limits indicated. Do not disturb portions of the site beyond the areas in which the Work is indicated.

1. Owner Occupancy: Allow for Owner occupancy and use by the public of the existing facility, including all buildings and grounds.

2. The Construction Manager shall confine his operations including storage of materials, supplies, equipment, and apparatus to the areas bounded by the contract limits indicated and as directed in the Contract Documents.

3. Existing roads, drives, walks, and parking areas which are not within the contract limit line are to be kept free and clear at all times. All deliveries for the project are to be scheduled and routed per the Construction Manager's and Owner approved Logistics Plan. The Construction Manager shall check all [Insert] roadways for accessibility and clearances for deliveries of all large material and equipment. The Construction Manager shall inform the Owner's Representative at least seventy-two (72) hours in advance of these deliveries so they can be coordinated with the Agency so appropriate traffic control, etc. can be provided. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

4. The Construction Manager shall be responsible for keeping the premises clean and shall pick up rubbish and debris and promptly remove from site.

5. Parking for the Construction Manager's employees will be limited to an area designated by the Owner's Representative, and the Construction Manager may be required to provide identification stickers for all employees' cars.

6. Special precautions shall be taken to protect all wetland areas designated to remain. Prevent any and all sediment, debris, or other materials from getting into these areas. Should any sediment, debris, or other materials get into these areas or if any damage occurs to the vegetation therein, the Construction Manager shall immediately contact the Owner's Representative for direction.

7. The Construction Manager shall comply with local working hour restrictions, unless specifically approved otherwise in writing by the Owner.

8. No signs, other than those approved by the Owner's Representative, will be visible on the premises.

C. Use of the Existing Building: Maintain the existing buildings, including Pielz, Jennings, Morrill, and TET, in a weather-tight condition throughout the construction period. Repair damage caused by construction operations. Take all precautions necessary to protect the building and its occupants during the construction period. Note: Check with Agency special types of conditions. The Construction Manager's personnel are not allowed to use the Cafeteria or vending machines within the existing buildings unless authorized in writing by the Agency and Owner.

1.7 OCCUPANCY REQUIREMENTS:

A. Full Agency Occupancy During Construction: The Owner reserves the right to allow the Agency to occupy the site and existing building during the entire construction period. Cooperate with the Agency during construction operations to minimize conflicts and facilitate Agency usage. Perform the Work so as not to interfere with the Agency's operations.

1. Provide adequate building and fire code egress from the buildings during the renovation process and/or as indicated on the Contract Documents. The Construction Manager will be responsible to maintain and protect egress ways during the construction sequence as required and/or indicated in the Contract documents. The Construction Manager shall be responsible for preparing egress plans for Owner approval and for Office of State Building Official and Office of State Fire Marshal for approval if required.

B. Partial Agency Occupancy: The Owner reserves the right to allow the Agency to occupy and to place and install equipment in completed areas of the building prior to Substantial Completion, provided such occupancy does not interfere with completion of the Work. Such placing of equipment and partial occupancy shall not constitute acceptance of the total Work.

C. No Occupancy: Agency will not occupy the building or any completed portions thereof prior to Substantial Completion of the Work.

1.8 PRODUCTS ORDERED IN ADVANCE:

A. General: The Owner has negotiated purchase orders with suppliers of material and equipment to be incorporated into the Work. The Owner has assigned these purchase orders to the Contractor. Costs for receiving handling and storage, and installation are included in the Guaranteed Maximum Price (GMP).

1. The Construction Manager's responsibilities are the same as if the Construction Manager negotiated the purchase orders. If necessary, the Construction Manager shall renegotiate purchase and execute final purchase-order agreements.

2. A "Schedule of Products Ordered in Advance", if applicable, is included at the end if this section.

1.9 OWNER-FURNISHED PRODUCTS:

A. The Owner may furnish various products such as laboratory equipments and/or as indicated in the construction documents. The Work includes providing support systems to receive Owner's equipment, and mechanical and electrical connections.

1. The Owner will arrange for and deliver necessary shop drawings, product data, and samples to the Construction Manager.
2. The Owner will arrange and pay for delivery of Owner-furnished items according to the Construction Manager CPM Schedule.
3. Following delivery, the Owner will inspect items delivered for damage.
4. If Owner-furnished items are damaged, defective, or missing, the Owner will arrange for replacement.
5. The Owner will arrange for manufacturer's field services and for the delivery of manufacturer's warranties to the Construction Manager.
6. The Construction Manager shall designate delivery dates of Owner-furnished items in the Construction Manager CPM Schedule.
7. The Construction Manager shall review shop drawings, product data, and samples and return them to the Architect noting discrepancies or problems anticipated in use of the product.
8. The Construction Manager is responsible for receiving, unloading, and handling Owner-furnished items at the site.
9. The Construction Manager is responsible for protecting Owner-furnished items from damage, including damage from exposure to the elements. The Construction Manager shall repair or replace items damaged as a result of his operations.

1.10 MISCELLANEOUS PROVISIONS:

A. Examination of Site:

1. It is not the intent of the Documents to show all existing conditions. All Subcontractors are advised to attend the Construction Manager's Pre-bid Conferences prior to submitting their Bid Proposals to the Construction Manager. This is the only official opportunity to visit and examine the site with the Owner, Agency, Architect, Engineer and Owner's Representative.
2. The Construction Manager should investigate and satisfy themselves as to the conditions affecting the work, including but not restricted to those bearing upon transportation, disposal, handling and storage of materials, availability of labor, water, electric power, uncertainties of weather, roads or similar physical conditions of the ground, the character of equipment, and facilities needed preliminary to and during the prosecution of the Work. The Construction Manager should further satisfy themselves as to the character, quality, and quantity of surface and subsurface materials or obstacles to be encountered insofar as this information is reasonably ascertainable from an inspection of the site, as well as from information presented by the Contract Documents. Any failure by the Construction Manager to acquaint themselves with the available information shall not relieve them from the responsibility for estimating properly the difficulty and cost of successfully performing the Work.
3. If tests have been done for Asbestos containing Material (ACM), and/or Lead Containing Material (LBP), the results are in the Appendix.
4. Tests have not been done for Work Involving "Products Containing Persistent Bioaccumulative Toxic Chemicals" (PBT's) such as Polychlorinated Biphenols (PCB's), Di-2-ethylhexyl Phthalate (DEHP) and Mercury, but Division 01 Section 01 35 16 "Alteration Project Procedures - CMR" states exposure limits and removal responsibility. If tests have been done for Work Involving "Products Containing Persistent Bioaccumulative Toxic Chemicals" (PBT's) such as Polychlorinated Biphenols (PCB's), Di-2-ethylhexyl Phthalate (DEHP) and Mercury, the results are in a separate volume of this Project Manual. Division 01 Section 01 35 16 "Alteration Project Procedures - CMR" states exposure limits and removal responsibility.

5. Subsurface Investigations:

a. Boring and test pit logs, and geotechnical laboratory test reports have been prepared for the site of this work and are in the Contract Documents.

b. If Geotechnical Reports(s) have been prepared for this project they are in the Appendix.

i. The Construction Manager must interpret the Geotechnical Report (s) according to their own judgment and acknowledges that he is not relying upon the data as accurately describing the subsurface conditions which may be found to exist.

ii. The Construction Manager further acknowledges that he assumes all risk contingents upon the nature of the subsurface conditions, which shall be actually encountered by them in performing the Work of this Contract.

iii. The Construction Manager should visit the site and become acquainted with all existing conditions and may make their own subsurface investigations to satisfy themselves as to the subsurface conditions. Such investigations shall be conducted only under time schedules and arrangements approved in advance by the Owner.

c. Subsurface Contaminated Soils Investigations:

i. If a Contaminated Soils Report has been prepared for this Project it would be included in the Appendix. The Owner shall be responsible for the remediation and disposal of all Contaminated Soils as indicated in this report.

ii. The Construction Manager shall be responsible for the excavation, staging, loading, transportation, and disposal of the Contaminated Soils indicated in the report. Refer to Division 02 Section 028000 – CONTAMINATED MATERIALS, EXCAVATION, STAGING, LOADING, TRANSPORTATION AND DISPOSAL for additional technical requirements and Contractor responsibilities.

iii. If the Construction Manager should encounter any material suspected or known to contain Contaminated Soils, that was not previously identified in the Contaminated Soils Report and assigned as the Construction Manager's responsibility, the Construction Manager should immediately notify the Owner of same. It is the Owner's responsibility to have the material tested and provide direction to the Construction Manager as to the required management of such materials in accordance with the provision of Section 02 60 00 "Excavated Soil and Material Management Plan." The Owner will respond within two (2) Calendar Days after receiving the Construction Manager written request for testing the suspect material. The Owner shall arrange for the remediation and disposal of all Contaminated Soils (if necessary) within a reasonable time period, i.e. within seven (7) Calendar Days.

iv. No attempt has been made to locate hazardous material associated with existing site utilities, though it is presumed that at least some asbestos may be discovered associated with underground piping during the course of site and site utilities work. If and when such materials appear, the Construction Manager shall notify the Owner, who shall direct additional work outside of this Contract to assist in cutting up and disposing of same. The Construction Manager shall assist the hazardous materials Subcontractor(s) with excavating, heavy lifting, and the like at no additional cost to the Owner.

B. Pre-Bid Conferences:

1. Pre-Bid Conferences and tours of the site will be conducted as scheduled by the Construction Manager. These scheduled conferences are the only official opportunity for the bidders to tour the site with the Owner, Agency, Architect, Engineer, and Owner's Representative.

C. Project Documents:

1. The Specifications and Drawings are intended to describe and illustrate the materials and labor necessary for the work of this Project.

2. Throughout the Technical Specifications, the Connecticut Department of Transportation Standard Specifications for Roads, Bridges, and Incidental Construction Form 816, current edition including any interim and supplemental specifications are referenced. Where so referenced the requirements set forth therein are applicable and made a part hereof. Copies of Form 816 are available from the Connecticut Department of Transportation at a nominal charge.

D. Site Logistics Plan(s): Site Logistics Plan(s) for this Project are in the Contract Documents. The Site Logistics Plan(s) describe in detail the proposed use of the Site and Building, both inside and outside the Contract Limit Area.

1. Related Section: Section 01 31 00, Project Management And Coordination – CMR, 1.5 Submittals, A, (4).

2. The Site Logistics Plan(s) include, but are not be limited to the following information:

a. phasing requirements;
b. proposed vehicle and equipment access routes;
c. locations of proposed staging/lay-down and storage areas, utility connections;
d. utilization of maintaining al least one elevator in use at all times;
e. occupant access to the elevator during construction;
f. delivery access of materials, handicap access;
g. building egress, proposed pedestrian traffic flows in the interior and exterior of the building;
h. temporary access-ways;
i. office trailer and dumpster locations;
j. location of perimeter construction fencing and gates;
k. other protection measures around and in the building(s);
l. temporary partitions, proposed pedestrian traffic flows around and in each building;
m. proposed building access points;
n. proposed protection measures for trees, shrubs and plantings, interior access-ways;
o. coordination of activities that relate to building occupants and other field applied measure to protect and coordinate the work including any relocation of utilities.

E. Scope Review:

1. Prior to signing Subcontracts, the Construction Manager will conduct a full Scope Review Meetings with each of the apparent Subcontractor Lowest Qualified Subcontractor Bidders to ensure that all of the requirements have been included within their bid. This scope review will highlight all of the specific requirements of the project, a review of the Construction Manager's procedures and all of the Technical sections of the contract documents. The Construction Manager's Scope Review Meetings shall be held with the CTDCS Project Manager, Architect/Engineer, and Owner's Representative in attendance.

2. This process will ensure that all of the Scope of Work included in the contract documents has indeed been included.

F. Drawings, Disks and Specifications Furnished:

1. The Construction Manager shall receive one (1) set of AutoCAD compatible (latest version) Floor Plans on disks from the Architect at no cost on or about the time of execution of the Contract. Additional sets of AutoCAD compatible (latest version) Floor Plans on disks may be provided to the CMR at the cost of their reproduction.

2. The Construction Manager will be given one (1) set–of the Contract Documents on or about the time of execution of the Contract, free of charge. If additional copies are wanted, they will be available at the direct additional cost of their reproduction, to the Construction Manager.

G. Construction Responsibility:

1. The Construction Manager shall be responsible for all construction means, methods, techniques, sequences, and procedures employed in the performance of all the of the Work and shall have full responsibility for any failures to carry out any part of the Work in accordance with the Contract Documents.

H. Overtime:

1. The Construction Manager shall request approval from the Owner to work overtime. Said request shall be made forty-eight (48) hours in advance. All costs for overtime are included in the Guaranteed Maximum Price as stated in Amendment 1 to the Agreement Between Owner and Construction Manager.

I. PMWeb Project Management:

1. The State of Connecticut Department of Construction Services (CTDCS) is using PMWeb as the project management collaborative software tool for this project.

2. The Construction Manager is required to utilize PMWeb for the duration of this project and shall provide all project information via this program. This includes, but is not limited to contracts, applications for payment, change orders, change order proposals, requests for information, etc.

3. The Construction Manager is required to purchase five (5) full PMWeb licenses to be utilized on the CTDCS PMWeb Hosted System from PSSGroup and maintain the licenses, software support, and hosting services through the duration of this project. At end of the project, these licenses shall be turned over to the CTDCS. The cost for the licenses, support of the licenses, and hosting fees shall be included by the Construction Manager in the General Conditions costs for this project.

4. The Construction Manager shall provide for a minimum of two (2) of formal PMWeb training through PSSGroup for the Owner's Representative, Owner, and their representatives. Training will be conducted at the CTDCS Training Room at the State Office Building, at 165 Capitol Avenue, Hartford, CT 06106. The training shall be coordinated through the CTDCS Project Manager and CTDCS PMWeb Staff. The cost for the training shall be included by the Construction Manager in the General Conditions costs for this project.

5. The Construction Manager shall contact PSSGroup, for the PMWeb licenses and training at http://www.pmweb.com , Phone: (617) 207-7080, or Fax: (978) 246-0248.

6. Connecticut Department of Construction Services (CTDCS) will be establishing a project specific email "file" address for this project. The Construction Manager shall send an electronic "file" copy of all project documents to this email address, to include but not limited to all project correspondence, project emails, forms, etc.

7. The Construction Manager is required to scan all documents that contain wet (ink) signatures and send a copy of those documents electronically to the CTDCS Project Manager and the project specific email "file" address. The hard copy of the wet signature documents shall be transmitted as directed by the CTDCS Project Manager. This includes, but is not limited to all contracts, change orders, applications for payment, etc.

J. Pursuant to C.G.S. Sec. 4a-101, the Construction Manager shall compile evaluation information during the performance of the contract on each of its subcontractors who are performing work with a value in excess of five hundred thousand dollars ($500,000.00). The Construction Manager shall complete and submit to the State of Connecticut Department of Construction Services (CTDCS) evaluations of each such Subcontractor upon fifty percent (50%) completion of the project and upon Substantial Completion of the project. The Construction Manager acknowledges that its failure to complete and submit these evaluations in a timely manner may, by statute, result in a delay in project funding and, consequently, payment to the Construction Manager. The Construction Manager agrees to indemnify and hold the State harmless from any loss, damage, or expense that results from or is caused by the Construction Manager's failure to complete and submit the evaluations to CTDCS in accordance with this provision.

K. Use of the BIM Model by the Owner and Construction Manager:

1. The Architect will make available the Building Information Model (BIM Model) to the Owner and Construction Manager to illustrate the design intent of the Project, and to enhance their general understanding of the Project. Use of the BIM Model is for reference only, and is limited to serving as a reference background for the following uses (Use or Uses):

a. Coordination of trade-authored fabrication models.

2. No use of the BIM Model shall be seen as suitable as, or providing a level of detail for, a fabrication-ready model.

3. The information in the BIM Model may be incomplete, inaccurate, corrupted, or defective due to many causes including, but not limited to: drafting errors, unforeseen alterations, program translation, or interoperability conflicts. The Owner and Construction Manager are not to rely upon the BIM Model and the data and /or information contained therein in preparing any of its documents for the project.

4. The Owner and Construction Manager acknowledge that the BIM Model is not part of the Construction or Contract Documents for the Project and the Architect makes no representations or warranties express or implied, regarding the BIM Model, the accuracy or completeness of the BIM Model, or the data and/or information contained therein.

5. The BIM Model is not being provided as a measurable, accurate, or complete documentation of the Project. The Owner and Construction Manager agree that the Architect and its Consultants have no responsibility or liability for any deficiencies, inaccuracies, errors, and/or omissions contained in the BIM Model or the data and/or information contained therein.

6. Any conflicts, errors, or discrepancies that are discovered during the Owner's and Construction Manager's use of the BIM Model, between the BIM Model and models prepared for the above-stated uses shall be promptly reported by the discovering party to the Architect. The Architect will assist the discovering party with the resolution of the conflicts, errors, or discrepancies.

7. The Owner, Construction Manager, and their agents, including but not limited to subcontractors, consultants, vendors, and material suppliers who intend to use the BIM Model for any or all of the above-stated uses, shall execute a "Digital Model End User Agreement" (BIM License) as prepared by the Architect, or similar document, acceptable to the Architect. The BIM License is strictly limited to the party executing the BIM License. Any transfer of the BIM model to parties other than those having executed the BIM

License with the Architect, is strictly forbidden. Any subcontractor requesting use the BIM model shall execute a separate BIM License.

8. The following is a sample of the “Digital Model End User Agreement” follows this Section.

PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01 11 00 - CMR

Centerbrook Architects and Planners, LLP ("Centerbrook")
Digital Model End User License Agreement

Centerbrook grants the undersigned the following license for the use of the Centerbrook's digital model ("Model") of:

Project: <Project>
Owner: <owner's name or company>
Model: File Name: <file name> Date:<date>

This license allows your use of this digital model for reference only to enhance your general understanding of the design intent for the project listed above.

The parties agree to the following terms and conditions:

1. Centerbrook is providing this model of the project design in a <Revit Version X, Navisworks, Other> format.
2. The Model is not being provided as a measurable, accurate, or complete documentation of the design.
3. The information in the Model may be incomplete, inaccurate, corrupted, or defective due to many causes including, but not limited to, drafting errors, unforeseen alterations, program translation, or interoperability conflicts.
4. This Model is one of a number of tools that the design team used to prepare the Contract Documents. The Contract Documents, in some cases, contain carefully extracted and enhanced elements of this model. However, the user should never assume that all elements of the model are accurate or identical to the Bidding or Contract Documents.
5. Any other use of this model, such as for technical analysis, clash detection, quantity assessment, dimensional interpretation, fabrication, or any other direct or indirect analysis, is strictly prohibited.
6. Any transfer to parties other than those listed here including your subcontractors is strictly forbidden.
7. This license will terminate upon Substantial Completion of the project as defined in the Contract Documents.

Your signature below indicates that you understand and accept that this model may conflict with the Contract Documents and may contain other errors. You understand that the model is not an element of the Contract Documents. Further you agree that your use of this model in any way, including the one(s) stated above, is solely at your own risk. You hold harmless and indemnify Centerbrook and the Owner from any and all claims and damages that may arise from your use of this model.

Agreed By:
Signature:_____ Date: _____

Printed Name and Title:_____

Company: _____

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Contract Documents and general provisions of the CMR Agreement Between Owner and Construction Manager and the Guaranteed Maximum Price (GMP) Amendment, including Division 00 General Conditions of the Contract for Construction – CMR and Supplementary Conditions, other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Unit Prices.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 01 Section 01 23 13 – CMR, "Supplemental Bids".
2. Division 01 Section 01 26 00 – CMR, "Contract Modification Procedures".
3. Division 01Section 01 29 76 – CMR, "Progress Payment Procedures".
4. Division 01 Section 01 77 00 – CMR, "Closeout Procedures".

1.3 OWNER'S CONTINGENCY ALLOWANCE:

A. This Section includes administrative and procedural requirements for Owner's Contingency Allowance~~s~~.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 01 Section 01 26 00 – CMR, "Contract Modification Procedures" for procedures for submitting and handling Change Orders.
2. Division 00 General Conditions of the Section 00 72 23 General Conditions Of The Contract For Construction For Construction Manager At Risk (CMR).
3. 00 52 23 Standard Form of Agreement Between Owner and Construction Manager-At-Risk (CMR) For Guaranteed Maximum Price (GMP) and Amendment 1.

C. Owner's Allowance:

1. The Construction Manager's costs for unloading and handling, labor, installation costs, storage, insurance, overhead and profit and other expense related to ~~the~~ Owner's Contingency Allowance items are included in the CMR's Guaranteed Maximum Price ("GMP").
2. Change Orders: All Owners' Contingency Allowance items shall follow the same procedures for submitting and handling of Change Orders in Division 01 Section 01 26 00 "Contract Modification Procedures".

1.4 UNIT PRICE: The monetary value stated by the Owner, as a price per unit of measurement for materials or services as described in Division 01 Section 01 20 00 Contract Considerations – CMR) and as accepted by the CMR in Section 00 42 23 CMR Fee Proposal Form.

1.5 UNIT PRICES – GENERAL:

A. This Section includes administrative and procedural requirements for unit prices.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 01 Section 01 26 00 "Contract Modification Procedures" for procedures for submitting and handling Change Orders.

2. Division 01 Section 01 29 76 "Progress Payment Procedures" for procedures for submitting Application for Payments.
3. Division 00 General Conditions Of The Contract For Construction For Construction Manager At Risk (CMR).
4. 00 52 23 Standard Form of Agreement Between Owner and Construction Manager-At-Risk (CMR) For Guaranteed Maximum Price (GMP) and Amendment 1.

C. Definitions:
   1. Unit Price: The Construction Manager acknowledged in the submittal of their Section 00 42 23 CMR Cost Proposal Form acceptance of the price per unit of measurement for materials or services as described in the Bidding Documents or in the Contract Documents.

D. Procedures:
   1. Unit Prices included in the Contract Documents are to be used for determining compensation to the Construction Manager or Owner for changes to the scope of the work indicated in the Contract Documents, and are included in the Guaranteed Maximum Price (GMP). Special Unit Prices are for items complete, in place, and shall be inclusive of furnishing and installing of all material, labor, trucking, overhead, profit, equipment, hoisting, engineering, scaffolding, power hookups, protection, shop drawings, taxes, permits, appliances, delivery, insurance, supervision, cost of bond, etc. and shall remain in effect until completion of the Contract.
   2. Unit Price: Is identified by the Owner as a price per unit of measurement for materials or services added to or deducted from the Guaranteed Maximum Price (GMP) by appropriate modification, if the estimated quantities of Work required by the Contract Documents are increased or decreased.
      a. Should the amount of the Work required be increased or decreased because of changes in the work ordered in writing by the DCS Project Manager, the Construction Manager agrees that the following supplemental UNIT PRICES will be decreased ten percent (10%) for a reduction of work. Each Unit Price shall include all equipment, tools, labor, permits, fees, etc., incidental to the completion of the work involved. All items marked with an asterisk (*) in the unit price schedules shall include the completion of the excavation, formation and compaction of sub-grade and the disposal of surplus or unsuitable materials in accordance with the Plans and Specifications or as directed by the DCS Project Manager.
   3. The Owner reserves the right to reject the Construction Manager’s measurement of work-in-place that involves use of established unit prices, and to have this work measured, at the Owner's expense, by an independent surveyor acceptable to the Construction Manager.
   4. Defect Assessment: Replace the Work, or portions of the Work, not conforming to the specified requirements. If, in the opinion of the Architect/Engineer, it is not practical to remove and replace the work the Architect/Engineer will direct an appropriate remedy or adjust the payment.
   5. Unit Price Schedule: A "Unit Price Schedule" is included at the end of this Section. Specification Sections referenced in the Schedule contain requirements for materials described under each unit price.

1.6 UNIT PRICE SCHEDULES

A. Unit Price Schedule - Earth and Rock Excavation: This Section includes administrative and procedural requirements for the following unit prices and provisions are to be included in and

become part of this Contract to be used in evaluating additions to or deductions from the work called for in the specifications and/or plans.

1. Unless otherwise specified elsewhere in these documents, the Construction Manager shall assume that all excavation is earth; however, if unspecified rock is encountered, it will be paid for at the given unit prices listed in Paragraph "C". Rock prices are net in that allowances for reduced quantities of earth are also included in the unit prices. The prices given include all costs for overhead, profit and rock surveys.
2. Wherever rock to be excavated is encountered, the Construction Manager shall strip or expose the rock to such an extent that in the Owner's opinion the necessary measurements can be taken. The Construction Manager shall provide the Owner with a survey by a licensed land surveyor indicating top of rock elevations at points of intersection on a rectilinear grid with lines spaced sufficiently close to show accurately the rock surface contours. At the Owner's option, an additional survey may be furnished by the Owner from a licensed surveyor.
3. If the conditions of the excavation work indicated are clearly of a special nature, the Construction Manager may ask the Owner for reconsideration of the established unit prices and if granted, the unit prices will not apply, and prices will be negotiated in accordance with Article 13 of the General Conditions.

B. Definitions:

1. "EARTH": Is defined as excavation shall include removal of all materials other than 'water' and 'rock'.
2. "ROCK": Is defined as a boulder of one cubic yard or more in volume (1/2 cubic yard for a boulder in trenches), and rock in definite ledge formation and masonry structures of one cubic yard or more in volume, the removal of which requires the use of mechanical equipment or the use of explosives. Rock removed by scarification or ripping method is considered as a separate classification under Paragraph 4.c.(1).
3. "ORIGINAL GRADE": Is defined as being the grade which exists at the time of Contract Award.
4. "ROUGH GRADE": Is defined as being the completed surface of required excavations greater than 13' in width.
5. "MASS": Excavation is to be considered as an open area whose minimum horizontal dimensions exceed 13'.
6. "TRENCH": Is defined as excavation is defined as the removal of material from areas 13 feet or less in its minimal horizontal dimensions and below the elevation of rough grade or original grade, whichever is lower.

C. Procedures:

1. Rock Excavation in Trenches: Basis for Horizontal Measurement:
   a. Horizontal Measurements: Will be taken between the vertical planes as defined below.
   b. The Minimum Width of Trenches in Rock: Will be taken as 3' 0".
   c. Excavation For Walls Or Piers With Footings: The measurements will be taken parallel to and one foot outside of the edges of the concrete footings as called for in the plans (i.e. for 4' 0" footing, rock will be taken as 6' 0" in width).
   d. Excavation For Walls Or Piers Without Footings: The limits of the excavation will be 1' 6" outside of the line of concrete at bottom as shown or called for in the plans (i.e. for a wall with a bottom thickness of 1' 0", the width of the trench will be considered to be 4' 0"). (Caissons are excluded from these measurements).
   e. Excavation for Pipe Lines: Will be measured at 2' 0" more than the nominal inside diameter of the pipe but in no case less than 3' 0" wide.

f. Excavation For Tanks, Vaults, Manholes, Pits, Etc.: Will be measured as 2' 0" greater in both length and width or diameter than the actual exterior dimensions of the structures and this excavation is considered to be trench only if any measured horizontal dimensions is 13' or less.

g. No allowance will be made for rock removed beyond the above limits.

2. Rock Excavation in Trenches - Basis for Vertical Measurement:

a. To determine depth of trench, vertical measurements will be taken from original grade or rough grade, (whichever is applicable), to the bottom of required excavation. These measurements will define the maximum depths for payments.

b. To determine quantity of rock in trench, vertical measurements will be taken from the top of rock as encountered in the trench to 12" below the bottom of required rock excavation. Any over excavation below the required elevation shall be filled with concrete or other material as specified at no cost to the Owner.

c. No allowance will be made for rock removed beyond the above limits.

3. Earth Excavation in Trenches - Basis of Measurement: (Horizontal & Vertical): The basis of measurements and allowance limit for earth excavation in trenches is identical to that indicated for rock excavation in trenches, except that there will be no allowance for 12" below the required elevation. In addition the following will prevail:

a. Maximum allowable widths for earth excavation in trenches without shoring:

Trench Depth - Classification	Add To Nominal ID Of Pipe Or To Footing Width
0 ft. - 6 ft.	3 ft.
Over 6 ft. - 10 ft.	5 ft.
Over 10 ft. - 15 ft.	7 ft.
Below 15 ft. deep the width of the trench shall be based on the individual case. The final depth of trench will determine the actual width for payment.	

b. If shoring is required the measurement shall be taken between the exterior walls of the shoring not to exceed 4' plus the I.D. of the pipe (for all depths).

c. To determine quantity of earth in trench, vertical measurements will be taken from the original or rough grade to actual bottom of earth excavation required.

4. Unit Prices - Earth and Rock Excavation (Basis for Payment): Prices include backfill with excavated material if it is suitable. Prices also include all excavation and disposal of all surplus or unsuitable material. Where replacement with the excavated material is prohibited or a particular backfill material is specified, the cost of the delivered replacement material in a volume equal to the above excavation pay limits minus the volume of the items installed in the trench shall be paid for a prior negotiated price. Prices do not include costs of shoring and de-watering but do include sloping for sides of excavation. Payment and credit amounts shall be determined in the following manner: Widths and depths of trench excavation as indicated. The total quantity of earth or rock excavation encountered in each depth payment category shall be paid for at its respective unit price as shown below. For example, in a 15' trench the first 6' will be paid for at the 0' - 6' price; the next 4' will be paid for at the over 6' - 10' price and the next 5' will be paid for at the over 10' - 15' price. Thus three different price brackets will prevail.

a.	Earth Excavation - Hand			Unit	$ Add	$ Deduct
	(1)	In Trenches - 0'. - 6'.		C.Y.	36.00	28.80
	(2)	In Trenches Below 6' Deep,		Prices Must Be Negotiated Before Work Is Started.		
b.	Earth Excavation - Machine			Unit	$ Add	$ Deduct
	(1)	Open Area	All Depths	C.Y.	18.81	15.05

	(2)	In trenches	0' - 4' deep	C.Y.	14.27	11.40
		Over	0' - 10' deep	C.Y.	19.71	15.75
		Over	0' - 15' deep	C.Y.	35.00	28.00
		Over	0' - 20' deep	C.Y.	75.00	60.00
c.	Rock Excavation			Unit	$ Add	$ Deduct
	(1)	Open Areas, Rock Removed By Ripping (Any Amount),				
		Net Rock		C.Y.	103.50	82.80
	(2)	Open Areas, With Explosives -				
		Net Rock -	Total Quantity Up To 100	C.Y.	126.00	100.80
			Total Quantity Up To 1,000	C.Y.	60.00	48.00
			Total Quantity Up To 1,000 or more	C.Y.	28.00	22.40

c.	Rock Excavation (Continued)			Unit	$ Add	$ Deduct
	(3)	In Trenches, Boulders, Remove By Machine		C.Y.	45.00	36.00
	(4)	In Trenches, Ripping Of Rock By Machine		C.Y.	105.00	84.00
	(5)	In trenches, with explosives				
		Net Rock	0' - 4' Deep	C.Y.	95.60	76.50
	(6)	In trenches, with explosives				
		Net Rock	0' - 10' Deep	C.Y.	125.00	100.00
	(7)	In trenches, with explosives				
		Net Rock	0 - 15' Deep	C.Y.	150.00	120.00
	(8)	In trenches, with explosives				
		Net Rock	Over 15' - 10' Deep	C.Y.	200.00	160.00
	(9)	In trenches, with explosives -				
		Net Rock	0 - 20' Deep,	Prices Must Be Negotiated Before Start Of Work.		
	(10)	Jack Holes (For Hydraulic Lift/Elevators)		L.F.	95.00	76.00
	(11)	Open Or Mass Areas - If Explosives Are Prohibited				
		Net Rock		C.Y.	125.00	100.00
	(12)	Trench Excavation - If Explosives Are Prohibited				
		Net Rock/With Rock Splitters And Jack Hammer or Hoe Ram		C.Y.	150.00	120.00

D. Unit Price Schedule - Miscellaneous:

1. Related Documents: Drawings and General Provisions of the Contract, including General and Supplementary Conditions and other Division 01 Sections, apply to this Section.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01 20 00 - CMR

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Construction Documents and general provisions of the CMR Agreement Between Owner and Construction Manager and the Guaranteed Maximum Price (GMP) Amendment, including Division 00 General Conditions of the Contract for Construction – CMR and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for handling requests for equals and substitutions made after award of the Contract.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 01 Section 01 33 00 "Submittal Procedures - CMR" specifies requirements for submitting the Contractor's Construction Schedule and the Submittal Schedule.
2. Division 01 Section01 42 20 "Reference Standards and Definitions - CMR" specifies the applicability of industry standards to products specified.
3. Division 01 Section 01 60 00 "Product Requirements - CMR" specifies requirements governing the Contractor's selection of products and product options.

1.3 DEFINITIONS

A. Definitions in this Article do not change or modify the meaning of other terms used in the Contract Documents.

B. Equals or Substitutions General: Changes in products, materials, equipment, and methods of construction required by the Contract Documents proposed by the Construction Manager after award of the Contract.

1.4 SUBMITTALS

A. Equals and Substitution Request Submittals: The Owner will consider requests for equals or substitutions if made prior to the Receipt of the Construction Manager's Subcontractor Competitive Bid. The information on all materials shall be consistent with the information herein. After the Construction Manager's Subcontractor contract award, substitutions will be considered for materials or systems specified that are no longer available. It will not be considered if the product was not purchased in a reasonable time after award. The Construction Manager shall submit all equal and substitutions requests on the *"Equal or Substitute Product Request"* Form, an example is shown at the end of this Section and the Form is available from the Owner's Representative (OR). See Article 15 in the General Conditions for further refinement and information.

1. The Construction Manager's is required to prepare and submit three (3) copies of the required data for the first manufacturer listed or procedure listed in the specifications section with reference to all of the following areas: the substance and function considering quality, workmanship, economy of operation, durability and suitability for purposes intended including the size, rating performance, LEED® compliance and cost. All submissions must include all the required data for the listed manufacturers or procedure as specified, as well as the required data for the proposed Equal or Substitution. This will enable the Owner and Architect to determine that the proposed Equal or Substitution is or is not substantially equal to the listed manufacturers or procedure.

2. Identify the product or the fabrication or installation method to be replaced in each request. Include related Specification Section and Drawing numbers.

3. Provide complete documentation showing compliance with the requirements for equals or substitutions, and the following information, as appropriate:

a. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by the Owner and separate contractors that will be necessary to accommodate the proposed Equal or Substitution.

b. A detailed comparison chart of significant qualities of the proposed substitution with those of the Work specified. Significant qualities may include elements, such as performance, weight, size, durability, and visual effect.

c. Product Data, including Shop Drawings and descriptions of products and fabrication and installation procedures.

d. Samples, where applicable or requested.

e. A statement indicating the effect on the Construction Manager's CPM Schedule compared to the schedule without approval of the Equal or Substitution. Indicate the effect on overall Contract Time.

f. Cost information, broken down, including a proposal of the net change, if any in the Guaranteed Maximum Price (GMP).

g. The Construction Manager's certification that the proposed Equal or Substitution conforms to requirements in the Contract Documents in every respect and is appropriate for the applications indicated.

h. The Construction Manager's waiver of rights to additional payment or time that may subsequently become necessary because of the failure of the Equal or Substitution to perform adequately.

4. Architect's Action: If necessary, the Architect will request additional information or documentation for evaluation within seven (7) Calendar Days of receipt of the original request for equal or substitution request. The Architect will notify the Owner's Representative who will notify the Owner of recommended acceptance or rejection of the proposed equal or substitution, within fourteen (14) days of receipt of the request, or seven (7) days of receipt of additional information or documentation, whichever is later. The Owner's Representative will give final acceptance or rejection by the Owner not less than seven (7) days after notification.

a. Any request deemed an "Equal" and accepted by the Owner's Representative, Architect, Owner, and Agency will result in written notification to the Construction Manager and will <u>not</u> be in the form of a change order for an "Equal".

b. Any request deemed a "Substitution" and rejected or approved by Owner's Representative, Architect, and Owner may result in written notification to the Construction Manager and may be in the form of a change order if the "Substitution" is approved.

PART 2 - PRODUCTS

2.1 EQUAL OR SUBSTITUTIONS

A. Conditions: The Architect will consider the Construction Manager's request for Equal or Substitution of a product or method of construction when one or more of the following conditions are satisfied, as determined by the Architect. If the following conditions are not satisfied, the Architect will return the requests to the Owner's Representative without action except to record noncompliance with these requirements.

1. The proposed request does not require extensive revisions to the Contract Documents.

2. The proposed request is in accordance with the general intent of the Contract Documents.

3. The proposed request is timely, fully documented, and/or properly submitted.

4. The proposed request can be provided within the Contract Time. However, the Architect will not consider the proposed request if it is a result of the Construction Manager's failure to pursue the Work promptly or coordinate activities properly.

5. The proposed request will offer the Owner a substantial advantage, in cost, time, energy conservation, or other considerations, after deducting additional responsibilities the Owner must assume. However, if the proposed request requires the Owner to incur additional responsibilities, including but not limited to, additional compensation to the Architect for redesign and evaluation services, increased cost of other construction by the Owner or similar considerations, then the Owner will have just cause to reject the request for Equal or Substitution.

6. The proposed request can receive the necessary approvals, in a timely manner, required by governing authorities having jurisdiction.

7. The proposed request can be provided in a manner that is compatible with the Work as certified by the Construction Manager.

8. The proposed request can be coordinated with the Work as certified by the Construction Manager.

9. The proposed request can uphold the warranties required by the Contract Documents as certified by the Construction Manager.

B. The Construction Manager's submission and the Architect's review of Submittals, including but not limited to, Samples, Manufacturer's Data, Shop Drawings, or other such items, which are not clearly identified as a request for an Equal or Substitution, will not be considered or accepted as a valid request for an Equal or Substitution, nor does it constitute an approval.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01 25 00 – CMR

Connecticut
Public Works

7001
Equal or Substitute Product Request

Page 1 of 1

Request Phase Pre-Bid ☐ Post Bid ☐ *(See Article 15 Materials: Standards, General Conditions)*

(If Pre-bid only) Current Bid Due Date: _____ **Request No.:** _____ **Dated:** _____

To: State of Connecticut
Department of Public Works

CTDPW Project No.: _____
Project Name / Location:

References: Specification(s): Section(s): _____ Paragraph(s): _____
Drawing(s): Drawing(s) No(s): _____ Detail(s) No(s): _____

Contractually Specified Product: _____
Contractor Proposed Product: _____

Proposed Product is : Equal: ☐ Substitute: ☐ Model No.: _____

*See attached data for **both** specified and proposed products as required by Article 15 General Conditions.*

Data attached: Drawings: ☐ Product Data: ☐ Reports: ☐ Samples: ☐
Tests: ☐ Other: _____

Reason(s) for not providing the Specified Product:

Similar Installation:
Project: Architect:
Address: Owner:
Date Installed:

Will proposed substitution impact other parts of the Work? No ☐ Yes ☐ *If yes attach explanation.*
Will proposed substitution increase Contract Time? No ☐ Yes ☐ *by number of Days* _____

Actual Dollar Savings to the State of Connecticut if substitution is accepted: $ _____

The Undersigned Certifies that the proposed Request for an Equal or Substitute Product conforms to all of the requirements of Division 01 General Requirements, Section 01 25 00 Substitution Procedures .

Request Submitted By General Contractor / CMR: _____
(Firm's Typed Name)

By: _____ *(Typed Name)* _____ *(Title)* _____ *(Signature)* _____ *(Date)*

CONTRACTOR / CMR Send copies to DPW PM: ☐ CA /OR: ☐

Consultant's Review – This Substitution Request is: Request Received on (Date): _____

☐ **Approved:** *(Submittals in accordance with Div. 01 General Requirements, Section 01 33 00 Submittal Procedures.)*
☐ **Approved as Noted:** *(Submittals in accordance with Div. 01 General Requirements, Section 01 33 00 Submittal Procedures.)*
☐ **Rejected:** **Use Specified Materials.**
☐ **Rejected:** **Request Not Received Within Specified Time Period - Use Specified Materials.**

Reviewed Issued By: _____ *(Typed Name)* _____ *(Signature)* _____ *(Date)*

CONSULTANT Send copies to: DPW PM: ☐ CA /OR: ☐ Chief Architect ☐ Chief Engineer ☐

If Approved: As noted by Consultant,
DPW Director of Project Management: _____ *(Signature)* _____ *(Date)*

Copies: Project File Red R2

CT DPW – 7001 (Rev: 101310) **7000 – Construction Phase Forms**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Construction Documents and general provisions of the CMR Agreement Between Owner and Construction Manager and the Guaranteed Maximum Price (GMP) Amendment, including Division 00 General Conditions of the Contract for Construction – CMR and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements for handling and processing contract modifications.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 01 Section 01 20 00 "Contract Considerations – CMR" for administrative requirements governing use of Unit Prices.

2. Division 01 Section 01 25 00 – CMR, "Substitution Procedures", for administrative procedures for handling requests for substitutions made after award of the Contract.

3. Division 01 Section 01 29 76 "Progress Payment Procedures – CMR", for administrative procedures governing Applications for Payment.

4. Division 01 Section 01 32 16.13 "CPM Schedules – CMR", for requirements for CPM scheduling and reporting progress of work.

6. Division 01 Section 01 33 00 "Submittal Procedures – CMR", for requirements for submittal of the Construction Progress Schedule or CPM Schedule.

7. Division 00 General Conditions of the Contract for Construction - CMR, Article 13 “Change Orders”.

1.3 REQUESTS FOR INFORMATION

A. In the event that the Construction Manager or their Subcontractor, at any tier, determines that some portion of the drawings, specifications, or other contract documents requires clarification or interpretation by the Architect, the Construction Manager shall submit a "Request for Information" in writing to the Architect and copy the Owner’s Representative. "Requests for Information" may only be submitted by the Construction Manager and shall only be submitted on the *"Request for Information"* Forms as required by the Owner.

1. In the "Request for Information", the Construction Manager shall clearly and concisely set forth the issue for which clarification or interpretation is sought and why a response is needed from the Architect.

2. In the "Request for Information", the Construction Manager shall set forth an interpretation or understanding of the requirement along with reasons why such an understanding was reached.

3. The Owner acknowledges that this is a complex project. Based upon the owner’s past experience with projects of similar complexity, the Owner anticipates that there will probably be some "Requests for Information" on this project.

4. The Architect will review all "Requests for Information" to determine whether they are valid "Requests for Information". If it is determined that the document is not a valid "Request for Information", it will be returned to the Construction Manager, unreviewed as to content, for resubmittal on the proper form and in the proper manner.

5. A "Requests for Information Response" shall be issued within seven (7) Calendar Days of receipt of the request from the Construction Manager unless the Owner determines that a longer time is necessary to provide an adequate response. If a longer time is determined

necessary by the Owner, the Owner will, within seven (7) Calendar Days of receipt of the request, notify the Construction Manager of the anticipated response time. If the Construction Manager submits a "Request for Information" on an activity with seven (7) Calendar Days or less of float on the current project schedule, the Construction Manager shall not be entitled to any time extension due to the time it takes the Architect to respond to the request provided that the Architect responds within the seven (7) Calendar Days set forth above.

6. A "Request for Information Response" from Architect will not change any requirement of the Contract Documents. In the event the Construction Manager believes that the "Request for Information Response" will cause a change to the requirements of the Contract Documents, the Construction Manager shall within five (5) Calendar Days give written notice to the DCS Project Manager and copy the Owner's Representative stating that the Construction Manager believes the "Request for Information Response" will result in a "Change Order" and the Construction Manager intends to submit a "Change Order Proposal" request. Failure to give such written notice five (5) Calendar Days shall waive the Construction's Manager right to seek additional time or cost under the requirement these Requirements.

1.4 MINOR CHANGES IN THE WORK

A. The Architect, with a copy to the Owner's Representative, will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Guaranteed Maximum Price (GMP) or Contract Time, on the *"Supplemental Instructions"* Form as required by the Owner.

1.5 PROPOSAL REQUEST

A. Architect/Owner-Initiated Requests For Proposals: The Architect or Owner will issue a detailed description of proposed changes in the Work to the Construction Manager with a copy to the Owner's Representative that will require adjustment to the Guaranteed Maximum Price (GMP) or Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications. Such requests shall be on a *"Proposal Request"* Form as required by the Owner.

1. "Proposal Request" is issued for information only. Do not consider them as an instruction either to stop work in progress or to execute the proposed change.

2. Within fourteen (14) Calendar Days of receipt of a "Proposal Request", submit a "Change Order Proposal" with the required information necessary to execute the change to the Construction Manager with a copy to the Owner's Representative for the Architect's/Owner's review.

a. Include a list of quantities of products required and unit costs, with the total amount of purchases to be made. Where requested, furnish survey data to substantiate quantities.

b. Indicate applicable delivery charges, equipment rental, and amounts of trade discounts.

c. Include a statement indicating the effect the proposed change in the Work will have on the Contract Time.

d. The Agency is tax exempt. All Construction Managers and their Subcontractors services provided under your Contract with the State of Connecticut may not be exempt from taxes. The Department of Revenue Services can guide you as to which services are exempt and which are not. Please contact the State of Connecticut, Department of Revenue Services at 1-800-382-9463 or 860-541-3280.

e. Dollar values shown on the Schedule of Values shall not be the governing (or deciding) final amounts for change orders involving either additional charges or deletions.

1.6 CHANGE ORDER PROPOSAL

A. When either a "Request for Information" from the Construction Manager or a "Proposal Request" from the Architect or Owner results in conditions that may require modifications to the Contract, the Construction Manager may propose changes by submitting a request for a "Change Order Proposal" to the Architect with a copy to the Owner's Representative on forms as required by the Owner. These forms shall also include "Change Order Proposal Worksheets" as required by the Owner.

1. Include statements outlining the reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Guaranteed Maximum Price (GMP) and Contract Time.
2. Include a list of quantities of products required and unit costs, with the total amount of purchases to be made. Where requested, furnish survey data to substantiate quantities as directed by of the Division 00 General Conditions of the Contract for Construction – CMR, Article 13.
3. Indicate applicable delivery charges, equipment rental, and amounts of trade discounts.
4. Comply with requirements in Division 01 Section 01 25 00 "Substitution Procedures - CMR" if the proposed change requires an equal or substitution of one product or system for a product or system specified.
5. The State of Connecticut construction contract has the following tax exemptions:

a. Purchasing of materials which will be physically incorporated and become a permanent part of the project.

b. Tools, supplies and equipment used in fulfilling the construction contract are not exempt.

c. Services that are resold by the Construction Manager are exempt, i.e. if a Construction Manager hires a plumber, carpenter or electrician, a resale certificate may be issued to their Subcontractor because these services are considered to be integral and inseparable component parts of the building contract

C. "Change Order Request" Forms: Use *"Change Order Proposal"* and "*Change Order Proposal Worksheets"* fForms as required by Owner.

D. A "Change Order Proposal" cannot be submitted without either prior submission of a "Request for Information" from the Construction Manager or as a response to a "Proposal Request" submitted by the Architect or Owner.

E. Any "Change Order Request" submitted without a prior submittal of a "Request for Information" or as a response to a "Proposal Request" will be immediately rejected and returned to the Construction Manager.

1.7 CONSTRUCTION CHANGE DIRECTIVE

A. "Construction Change Directive": When the Owner and the Construction Manager disagree on the terms of a "Change Order Proposal" resulting from either a "Request for Information" or "Proposal Request", then the Architect through the Construction Manager with a copy to Owner's Representative may issue a "Construction Change Directive" on a *"Construction Change Directive"* Form as authorized by the Owner. The "Construction

Change Directive" instructs the Construction Manager to proceed with a change in the Work, for subsequent inclusion in a "Change Order".

1. The "Construction Change Directive" contains a complete description of the change in the Work. It also designates the method to be followed to determine change in the Guaranteed Maximum Price (GMP) or Contract Time.
2. Construction Manager must proceed with the Work once a "Construction Change Directive" is issued.
3. The change in the Guaranteed Maximum Price (GMP) and Contract Time resulting from the issuance of a "Construction Change Directive" will be based on "Time & Material" or "Unit Prices".
4. Issuance of "Construction Change Directive" does not guarantee payment for the Work described in the "Construction Change Directive".

B. Documentation: The Construction Manager shall maintain detailed records on a time and material basis of work required by the "Construction Change Directive".

1. After completion of the change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.
2. The final value shall be negotiated based on the supporting data to determine the value of the work.

1.8 CHANGE ORDER PROCEDURES

A. Upon the Owner's approval of a Construction Manager's "Change Order Proposal", the Construction Manager with a copy to the Owner's Representative will prepare and distribute a "Change Order" for signatures of the Architect, Owner and the Construction Manager on a *"Change Order"* Form as required by the Owner.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01 26 00 - CMR

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Construction Documents and general provisions of the CMR Agreement Between Owner and Construction Manager and the Guaranteed Maximum Price (GMP) Amendment, including Division 00 General Conditions of the Contract for Construction – CMR and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies procedures for preparation and submittal of the Construction Manager's Applications for Payment.

B. Related Sections: The following Sections contain requirements that relate to this Section.

1. Division 00 General Conditions of the Contract for Construction – CMR: Articles: 27 "Schedule of Values, Application for Payment"; 28 "Partial Payments"; 31 "Final Payment"; and 32 "Owner's Right to Withhold Payments".

. Division 01 Section 01 32 16.13 "CPM Schedules - CMR" for requirements for CPM scheduling and reporting progress of work.

3. Division 01 Section 01 33 00 "Submittal Procedures - CMR" ".

4. Division 01 Section 01 77 00 "Closeout Procedures - CMR" for requirements for Final Payment.

1.3 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the "Schedule of Values" with preparation of the CPM Schedule. Use "Schedule of Values" form as required by the Owner

1. Submit the "Schedule of Values" to the Owner's Representative.

B. Format and Content: Use the Project Manual Table of Contents as a guide to establish the format for the "Schedule of Values". Provide at least one line item for each Specification Section on electronic media printout.

1. Arrange the "Schedule of Values" in tabular format as required by the Owner, containing separate columns including, but not limited to, the following Items:

a. Item Number.

b. Description of Work with Related Specification Section or Division Number.

c. Scheduled Values broken down by description number, type material, units of each material.

1) **Include break down of General Condition requirements, i.e. bonds, insurance premiums, taxes, job mobilization, temporary facilities, field supervision and layout, operation and maintenance manuals, punch list activities, project record documents, demonstration and training, overhead, LEED documentation, commissioning activities, and profit as separate line items.**

d. Name of Subcontractor.

e. Name of manufacturer or fabricator.

f. Name of supplier.

g. Retainage.

h. Guaranteed Maximum Price in sufficient detail.

2. Percentage of Guaranteed Maximum Price to nearest one-hundredth percent, adjusted to total 100 percent.
3. Provide a breakdown of the Guaranteed Maximum Price in sufficient detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual Table of Contents. Break principal subcontract amounts down into several line items. In addition, the following items listed below must be included.
   a. Site Logistics Plan (01 29 76- CMR) a lump sum at 1/20 of one percent of the base bid total project cost at the time of submission of this plan.
   b. Coordination Drawings (01 31 00 - CMR) a lump sum of this cost for payment at the submittal of this product a minimum cost of 1/10th of one percent of the base bid total project cost or $5,000 whichever is greater.
   c. Photographic Documentation (01 32 33- CMR) a monthly cost of $1,000 per month to be paid each month upon receipt of the photographs or forfeit of that month's payment.
   d. Submittal Schedule (01 33 00- CMR) a lump sum payment calculated at 1/20th of 1% of the base bid total project cost upon receipt of the schedule.
   e. Waste Collection & Cleaning (01 50 00- CMR) a monthly cost. A minimum payment of $1,000 to $3,000 (based on size & complexity of the project) with forfeit of that monthly payment if not done.
   f. As-Built Updates (01 31 00- CMR) a monthly cost, a minimum payment of $1,000 with forfeit of that monthly payment if not done.
   g. Start-up and Adjusting (01 75 00 - CMR) a lump sum cost upon completion. (to be determined by PM with A/E & OR advice)
   h. Schedule (01 32 16.13 - CMR) a lump sum payment upon receipt of the base line schedule. A payment of 40% of the total amount of the total cost which is to be calculated at 1/8th of one percent of the base bid total project cost. Monthly updates using the remainder of the cost divided evenly over the accepted schedule duration with a forfeit of the monthly payment of the update is not received on time.

      Any forfeited amounts being withheld by the Owner's Representative for non-performance will be adjusted at the final payment by a credit change order to the owner.
4. Round amounts to nearest whole dollar; the total shall equal the Guaranteed Maximum Price.
5. Unit-Cost Allowances: Show the line-item value of unit-cost allowances, as a product of the unit cost, multiplied by the measured quantity. Estimate quantities from the best indication in the Contract Documents.
6. General Conditions: Show line items for indirect costs and margins on actual costs only when such items are listed individually in Applications for Payment. Each item in the Schedule of Values and Applications for Payment shall be complete. Include the total cost and proportionate share of general overhead and profit margin for each item.
   a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the Schedule of Values or distributed as general overhead expense, at the Construction Manager's option.

1.4 APPLICATIONS FOR PAYMENT

A. Each Application for Payment shall be consistent with previous applications and payments as certified by the Architect and Owner's Representative and paid for by the Owner.

1. The initial "Application for Payment", the "Application for Payment" at time of "Substantial Completion", and the final "Application for Payment", involve additional requirements.

B. Payment-Application Terms: The Owner will process monthly progress payments. The Construction Manager may submit applications for payment on a monthly basis.

C. Payment-Application Forms: Use the "Application for Payment" form AIA G702 and Continuation Sheet G703. Present the required information on electronic media printout or Owner approved form; multiple pages should be used if required.

1. For each item, provide a column including but not limited to the following items:

a. Item Number.

b. Description of Work and Related Specification Section or Division.

c. Scheduled Value, break down by units of material and units of labor.

d. Work Completed from previous application.

e. Work Completed this period.

f. Materials presently stored.

g. Total Completed and stored to date of application.

h. Percentage of Completion.

i. Balance to Finish.

j. Retainage.

D. Application Preparation: Complete every entry on the Application form. At the time of Final Payment only, include an executed Application form by a person authorized to sign legal documents on behalf of the Construction Manager. The Owner's Representative will return incomplete Applications without action.

1. Entries shall match data on the "Schedule of Values".

2. Include amounts of Change Orders issued prior to the last day of the construction period covered by the application.

3. Provide submission at same time each month. Submit a pencil copy 5 days prior to formal submission to allow for comments from the Owner's Representative. A review meeting will be scheduled, if required, to address any question or concerns.

E. Transmittal: Except for final payment, submit to the Owner's Representative by a method ensuring receipt within forty-eight (48) hours. One (1) complete, signed and notarized original of each Application for Payment, including lien waivers and similar attachments when required, along with six (6) copies. For Final Payment, nine (9) complete, or as directed by the Owner through the Owner's Representative; signed and notarized copies shall be submitted.

1. Transmit each copy with a transmittal form listing attachments and recording appropriate information related to the application, in a manner acceptable to the Architect.

F. Applications for Payment: Administrative actions and submittals, that must precede or coincide with submittal of the first Application for Payment and all subsequent Application for Payments including, but not limited to, the following items:

1. Submit a pencil copy 5 days prior to formal submission to allow comments from Owner's Representative, followed by a review meeting, if required, to address any concerns.

2. All submission and financial reporting requirements of PM Web.

G. Application for Payment at Substantial Completion: Following issuance of the Certificate of Substantial Completion submit an Application for Payment form; use the form as required by

the Owner. Present the required information on electronic media printout as applicable that include, but are not limited, to the following:

1. List of Subcontractors and suppliers' name, FEIN/Social Security numbers, and Connecticut Tax Registration Numbers.

2. List of principal suppliers and fabricators.

3. Schedule of Values.

4. Construction Manager's CPM Schedule (preliminary if not final).

5. Schedule of principal products.

6. Submittal Schedule (preliminary if not final).

7. List of Contractor's staff assignments.

8. List of Contractor's principal consultants.

9. Copies of all applicable permits.

10. Copies of authorizations and licenses from governing authorities for performance of the Work.

11. Proof that Subcontractors have been paid amounts included on the Construction Manager's Application for Payment within thirty (30) days after the Owner has paid the Construction Manager for the particular Application for Payment in accordance with Connecticut General Statute § 49-41a (a)(1).

12. Releases of Lien from Subcontractors with amounts included on the Construction Manager's Application for Payment when Construction Manager has been paid by the Owner for the particular Application for Payment but the Subcontractors have not been paid.

13. Proof that as-built documents are updated as required by Section 01 77 00- CMR "Closeout Procedures.

14. Initial as-built survey and damage report, if required.

15. Update the Construction Manager's Master Subcontract Agreement List" and submit copies all recently executed Subcontract Agreements in accordance with CGS § 4b-96.

15.1 . The Construction Manager's Master Subcontract Agreement List" shall list all Subcontract Agreements in order of Guaranteed Maximum Price magnitude (from high to low) in the following format:

Construction Manager's Master Subcontractor Agreement List"				
Subcontractor Name	Minority Or Small Business Designation	Trade	Address	Guaranteed Maximum Price

16. In accordance with CGS § 42-158j (b):
Each payment requisition submitted shall include a statement showing the status of all pending construction change orders, other pending change directives and approved changes to the original contract or subcontract. Such statement shall identify the pending construction change orders and other pending change directives, and shall include the date such change orders and directives were initiated, the costs associated with their performance and a description of any work completed. As used in this section, "pending construction change order" or "other pending change directive" <u>means an authorized directive for extra work that has been issued to a contractor or a subcontractor and</u>

identified by an official Change Order Number or Construction Change Directive Number assigned by the State of Connecticut.

G. Final Payment Application: Administrative actions and submittals that must precede or coincide with submittal of the final Application for Payment include, but are not limited, to the following:

1. Completion of Project Closeout requirements.

2. Completion of list of items remaining to be completed as indicated on the attachment to the Certificate of Substantial Completion.

3. Ensure that unsettled claims will be settled.

4. Ensure that incomplete Work is not accepted and will be completed in accordance with a schedule prepared by the Construction Manager which is acceptable to the Owner.

5. Transmittal of required Project construction records to the Owner (including as-built documents specified in Section 01 77 00 "Closeout Procedures - CMR".

6. Certified property survey.

7. Proof that taxes, fees, and similar obligations were paid.

8. Removal of temporary facilities and services.

9. Removal of surplus materials, rubbish, and similar elements (Reference Section 01 74 19 “Construction Waste Management & Disposal – CMR”.

10. Change of door locks to Owner's access.

11. The requirements of the Division 00 General Conditions - CMR and Supplementary Conditions for Final Acceptance, Final Completion, Final Inspection, and Final Payment.

12. Asbestos, lead or other hazardous material manifests.

13. Completion of "Building Contractor Reporting Form" as supplied by Department of Public Works, for all Construction Manager’s Subcontractors, Vendors, Suppliers, etc. who work on the Contract. The form includes the following information:

a. Construction Manager / Subcontractor name.

b. FEIN/Social Security Numbers

c. Connecticut Tax Registration Numbers

d. Type of work

e. Name of business and address

f. Remittance address.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01 29 76 - CMR

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Construction Documents and general provisions of the CMR Agreement Between Owner and Construction Manager and the Guaranteed Maximum Price (GMP) Amendment, including Division 00 General Conditions of the Contract for Construction – CMR and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and supervisory requirements necessary for coordinating construction operations including, but not necessarily limited to, the following:

1. General project coordination procedures.
2. Conservation.
3. Coordination Drawings, including Site Logistics Plans.
4. Administrative and supervisory personnel.
5. Cleaning and protection.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division Section 01 01 11 00 “Summary of Work - CMR” 1.10 Miscellaneous Provisions, (D) Site Logistics Plans.
2. Division 01 Section 01 29 76 “Progress Payment Procedures - CMR” for Schedule of Values items
3. Division 01 Section 01 31 19 "Project Meetings - CMR" for progress meetings, coordination meetings, and pre-installation conferences.
4. Division 01 Section 01 32 16.13 "CPM Schedules - CMR" for requirements for CPM scheduling and reporting progress of work.
5. Division 01 Section 01 50 00 "Temporary Facilities and Controls- CMR".
6. Division 01 Section 01 60 00 "Product Requirements – CMR" for coordinating general installation.
7. Division 01 Section 01 71 23 "Field Engineering – CMR" specifies procedures for field engineering services, including establishment of benchmarks and control points.
8. Division 01 Section 01 77 00 "Closeout Procedures - CMR" for coordinating contract closeout.
9. Division 01 Section 01 91 00 "Commissioning - CMR" defines the commissioning process.

1.3 OWNER’S REPRESENTATIVE

A. Owner’s Representative:

1. The Owner’s Representative is identified in Division 01 Section 01 11 00 "Summary of Work - CMR".
2. Construction Mobilization:
   a. Cooperate with the Architect and DCS PM in the allocation of mobilization areas of the site, for field offices and sheds, for agency facility access, traffic, and parking facilities.
   b. During Construction, coordinate use of site and facilities through the Architect and DCS PM.

c. Comply with Architect and DCS PM procedures for intra-project communications; submittals, reports and records, schedules, coordination drawings, and recommendations; and resolution of ambiguities and conflicts.

d. Comply with instructions of the Architect and DCS PM for use of temporary utilities and construction facilities.

e. Coordinate field engineering layout as specified in Division 01 Section 01 71 23 "Field Engineering" for work under the instructions of the Architect or/and DCS PM.

3. Commissioning
This project will have selected building systems commissioned. The Commissioning process and equipment and systems to be commissioned are specified in Division 01, Section 01 91 00. The Commissioning process will be directed by a Commissioning Agent whose services will be provided by the Owner. The CMR shall coordinate all their Commissioning responsibilities through the Owner's Representative.

1.4 COORDINATION

A. Coordinate construction operations included in various Sections of these Specifications to assure efficient and orderly installation of each part of the Work. Coordinate construction operations included under different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in the sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.

2. Coordinate installation of different components to assure maximum accessibility for required maintenance, service, and repair.

3. Make provisions to accommodate items scheduled for later installation.

B. Where necessary, prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and attendance at meetings.

1. Prepare similar memoranda for the Construction Manager, Owner and separate contractors where coordination of their work is required.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and assure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of schedules.

2. Installation and removal of temporary facilities.

3. Delivery and processing of submittals.

4. Progress meetings.

5. Project closeout activities.

6. As-Builts coordinate monthly meetings to assure up-dates being performed

1.5 SUBMITTALS

A. Coordination Drawings: Prepare coordination drawings to complete detailed coordination of systems and components and to integrate information about fabrication and installation.

1. Thoroughly prepare coordination drawings, as further stipulated in Part 3 "Execution", reviewing all contract documents and consulting with all entities contributing to or involved with each portion of the work under consideration.

a. Show the relationship of all components shown on any separate Shop Drawings.

b. Indicate required desired installation sequences.

c. Comply with requirements contained in Division 01 Section 01 33 00 "Submittal Procedures".

2. Prepare coordination drawings for installation of all products and materials fabricated by separate entities.

3. Prepare coordination drawings where limited space availability necessitates maximum utilization of space for efficient installation of different components, including but not limited to: all site-utility entry points; all ceiling and roof cavities in all areas; all electrical, telecommunications and mechanical rooms; all stage-boundary interface areas; all laboratories, animal-handling rooms and data rooms; all classrooms and seminar rooms; all lecture halls and their support spaces; all video studios, broadcast classrooms and their support facilities; and all such other conditions required to coordinate the work.

4. Prepare a Site Logistics Plan(s) showing: The entire project area and limits; all routes into and out of site; all staging and stockpiling and lay-down areas; all aspects of phasing/staging; all parking, paving and fencing; and all specific provisions to satisfy requirements of Division 01 Sections, including but not limited to Field Engineering and Temporary Facilities and Controls. The Site Logistics Plan shall coincide with and complement the general staging plans and site plans outlined in the contract bidding documents. It is intended that the Construction Manager shall present this refined plan for approval by the Owner's Representative. The fencing shown on this plan is required for all phases. Exact placement and timing of installations and removals will be reviewed and approved by the Architect and DCS PM prior to implementation. An additional allotment of various fencing is specified in Division 32, which the Construction Manager shall provide, install, and relocate at various intervals, for installation and removal by the Construction Manager per the direction of the project's Owner's Representative. This staging and logistics plan will require refinement and change for each phase/stage of the project. The Site Logistics Plan(s) shall be drawn at a scale no smaller than 1"=40' and shall be submitted as stipulated in Division 01 Section 01 29 76 "Progress Payment Procedures", but in no case later than (30) days after Notice to Proceed.

5. Prepare coordination drawings showing locations of surface recesses and voids, as well as offsets and breaks, requiring filling and/or feathering, both those initially visible and those discovered during the course of work. Review with Owner and Architect to obtain direction for filling and feathering. Revise drawing(s) to record directions for same for field and record purposes.

B. Staff Names: Prior to the contract start date, submit a list of the Construction Manager's principal staff assignments, including the superintendent, project safety officer, and other personnel in attendance at the Project Site. Identify individuals and their duties and responsibilities. List their addresses and telephone numbers, including emergency contact numbers.

1. Post copies of the list in the Project meeting room, the temporary field office, and at each temporary telephone.

2. Provide resumes of each staff member proposed for the Project. This shall include the Project Manager, Project Superintendent and Safety Officer.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 GENERAL COORDINATION PROVISIONS

A. Inspection of Conditions: Require the Installer of each major component to inspect both the substrate and conditions under which Work is to be performed and coordinate such inspections with the Architect and DCS PM and authorities having jurisdictions. If unsatisfactory conditions exist notify the Architect and DCS PM immediately. Do not proceed until unsatisfactory conditions have been corrected in an acceptable manner.

B. The Construction Manager shall coordinate temporary enclosures with required inspections and tests to minimize the necessity of uncovering completed construction for that purpose.

C. Coordination Drawings: Before construction work can begin, the Construction Manager shall submit to the Architect coordination drawings in the form of (a) electronic forms and prints at not less than 1/4-inch scale and (b) CAD files of the coordination drawings on CDROM. Such drawings will be required throughout all areas for trades as described below. These drawings shall show resolutions of trade conflicts in congested areas. The Architect will supply base drawings (with the title blocks removed), including floor plans, reflected ceiling plans, and structural framing plans, in the form of electronic CAD files on CDROM, using the AutoCAD release edition specified with the files, to the Construction Manager for distribution to the trades for use in developing the coordination drawings. Each trade Construction Manager's Subcontractor shall create separate layers within the CAD files to show the work of their trade. Prepare coordination drawings as follows:

1. The Construction Manager's HVAC Subcontractor shall initiate 1/4-inch scale drawings done on AutoCAD (latest version) showing ducts and piping in plan and section. Sheet metal shop drawings must be approved prior to starting coordination drawings.

2. The Construction Manager's Sprinkler Subcontractor shall then add layers to superimpose his piping layout on the coordination drawings.

3. The Construction Manager's Electrical Subcontractor shall then add layers to superimpose all the electrical information on the coordination drawings. Said information is to include but not necessarily be limited to cable trays, equipment, lighting, conduits, bus duct, etc. Show space allowances reserved for work under other contracts, such as audio-visual wiring and equipment.

4. The Construction Manager's Plumbing Subcontractor shall then add layers to complete the coordination drawing by drawing his piping (including pitch) on the coordination drawings.

5. Construction Manager's Subcontractors for specialties, furnishings, equipment and special construction shall add layers to show their work to assure full coordination of all systems.

6. The Owner's Representative shall review the completed coordination drawings for general compliance and then submit them to the Architect for his review. All Construction Manager's Subcontractors shall rework the drawings until all systems are properly coordinated.

7. The Construction Manager's Ceiling Subcontractor shall utilize the drawings to prepare acoustic panel ceiling drawings and any other suspended ceiling drawings, and shall indicate areas of conflict with the work of other trades by drafting the location of grids, panels and tiles.

8. The Construction Manager shall indicate Architectural/Structural conflicts or obstacles and coordinate to suit the overall construction schedule. The Construction Manager shall locate all precut and prefabricated holes and openings in structural steel on the CAD

coordination drawing files as required for HVAC, plumbing, fire protection and electrical work. The Construction Manager shall coordinate these holes and openings with the structural steel fabricator during the structural steel shop drawing development phase. Coordination to take place on schedule so as to permit shop fabrication of all structural steel holes and openings. The Owner will not be held responsible for the costs associated with field fabrication of structural openings resulting from the lack of timely and thorough coordination.

9. The Construction Manager shall expedite all drawing work and coordinate to suit the construction schedule. The Construction Manager shall then review these drawings and compare them with the Architectural, Structural, Equipment, and other drawings and determine that all of the work can be installed without undue interference. Prior to the submittal to the Architect, areas of potential conflict shall be brought to the attention of the Construction Manager who shall convene a coordination meeting of all parties involved, for the purpose of resolving all utility conflicts. The Construction Manager shall supervise and direct corrective measures and have all trades sign acceptance of the drawings. Submit four (4) hard copies of each drawing to the Architect and two (2) copies to the Owner's Representative for the record, and only after all conflicts have been accommodated.

10. If the coordination meeting fails to resolve coordination conflicts, the Construction Manager shall indicate the nature of such conflicts in a detailed RFI, proposing the most economical solution.

11. The Construction Manager shall not permit work by trades to proceed in a given bay or area until all trade foremen agree on the exact arrangements for each room or area. If a given trade proceeds prior to trades approval, then if necessary, that trade shall revise their work, if necessary, at no extra cost, in order to permit other trades to proceed.

12. Submit all coordination drawings on CD-ROM, in addition to hard copy.

D. The Owner's Representative will meet with the Construction Manager on all major items of coordination.

3.2 CLEANING AND PROTECTION

A. Clean and protect construction in progress and adjoining materials in place, during handling and installation. Apply protective covering, where required, to assure protection from damage or deterioration.

B. Clean and provide maintenance on completed construction as construction per manufacturers requirements through the remainder of the construction period. Adjust and lubricate operable components to assure operability without damaging effects.

C. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period. Where applicable, such exposures include, but are not limited to, the following:

1. Excessive static or dynamic loading.
2. Excessive internal or external pressures.
3. Excessively high or low temperatures.
4. Thermal shock.
5. Excessively high or low humidity.
6. Air contamination or pollution.
7. Water or ice.
8. Solvents.
9. Chemicals.

10. Light.
11. Radiation.
12. Puncture.
13. Abrasion.
14. Heavy traffic.
15. Soiling, staining, and corrosion.
16. Bacteria.
17. Rodent and insect infestation.
18. Combustion.
19. Electrical current.
20. High-speed operation.
21. Improper lubrication.
22. Unusual wear or other misuse.
23. Contact between incompatible materials.
24. Destructive testing.
25. Misalignment.
26. Excessive weathering.
27. Unprotected storage.
28. Improper shipping or handling.
29. Theft.
30. Vandalism.

END OF SECTION 01 31 00 - CMR

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Construction Documents and general provisions of the CMR Agreement Between Owner and Construction Manager and the Guaranteed Maximum Price (GMP) Amendment, including Division 00 General Conditions of the Contract for Construction – CMR and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements for project meetings, including, but not limited to, the following:

1. Start Date meeting (establishes start date)
2. Pre-construction conferences.
3. Pre-installation conferences.
4. Progress meetings.
5. Safety
6. Coordination
7. As-built drawings review
8. And as required

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 01 Section 01 31 00 "Project Management and Coordination - CMR" for procedures for coordinating project meetings with other construction activities.
2. Division 01 Section 01 32 16.13 "CPM Schedules - CMR" for requirements for CPM scheduling and reporting progress of work.
3. Division 01 Section 01 33 00 "Submittal Procedures - CMR" for submitting the Construction Schedule or CPM Schedule.
4. Division 01 Section 01 35 26 “Government Safety Requirements- CMR” specifies the requirements for safety plans, reports, and investigation submittals.
5. Division 03 Section 03 45 00 "Precast Architectural Concrete" for pre-installation/erection conferences.
6. Division 07 Section 07 50 00 "Membrane Roofing" for pre-construction conferences.

1.3 PRE-CONSTRUCTION CONFERENCE

A. The Construction Manager will attend a pre-construction conference before starting construction, as scheduled by the Owner’s Representative convenient to the Owner, the Owner’s Representative, Architect, and Construction Manager. This meeting will take place at least fourteen (14) Calendar Days prior to official Start Date. Hold the conference at the Project Site or another convenient location as directed by the Construction Manager.. The Construction Manager shall conduct the Pre-construction Conference to review the Construction Manager and their Subcontractor responsibilities and personnel assignments.

B. Attendees: Authorized representatives of the Owner’s Representative, Owner, Architect, and their consultants; the Construction Manager and its superintendent; major subcontractors; agency; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with the Project and authorized to conclude matters relating to the Work.

C. Agenda: Discuss items of significance that could affect progress, including the following:

1. Tentative construction schedule.
2. Critical work sequencing.
3. Progress meeting schedule.
4. Designation of responsible personnel.
5. Procedures for processing field decisions and Change Orders.
6. Procedures for processing Applications for Payment.
7. Distribution of Contract Documents.
8. Submittal of Shop Drawings, Product Data, and Samples.
9. Preparation of record documents.
10. Use of the premises.
11. Parking availability.
12. Office, work, and storage areas.
13. Equipment deliveries and priorities.
14. Safety procedures.
15. First aid.
16. Security.
17. Housekeeping.
18. Working hours.
19. Coordination with Audio Visual and Telecommunications.
20. Work rules.

1.4 PRE-INSTALLATION/CONSTRUCTION CONFERENCES

A. The Construction Manager will schedule a pre-installation conference(s) at the Project Site before each construction activity that requires coordination with other construction. The Construction Manager shall be responsible to notify in writing the Owner's Representative and the appropriate Subcontractor(s), etc., of the date and time of all Pre-installation/Construction Conferences. Notification shall be at least seven (7) Calendar Days, prior to the Conference. The Construction Manager shall be responsible for coordination and attendance of all Subcontractors, etc., involved in or affected by the installation for all Pre-installation/Construction Conferences.

B. Attendees: The Owner's Representative, Construction Manager, Subcontractors, Owner and Architect, the installer and representatives of manufacturers and fabricators involved in or affected by the installation, and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. The Construction Manager shall advise all attendees of the scheduled Pre-installation/Construction Conferences dates.

C. Review the progress of other construction activities and preparations for the particular activity under consideration at each Pre-installation/Construction Conference, including but not limited to the following requirements:

1. Contract Documents.
2. Options.
3. Related Change Orders.
4. Purchases.

5. Deliveries.
6. Shop Drawings, Product Data, and quality-control samples.
7. Review of mockups.
8. Possible conflicts.
9. Compatibility problems.
10. Time schedules.
11. Weather limitations.
12. Manufacturer's recommendations.
13. Warranty requirements.
14. Compatibility of materials.
15. Acceptability of substrates.
16. Temporary facilities.
17. Space and access limitations.
18. Governing regulations.
19. Safety.
20. Inspecting and testing requirements.
21. Required performance results.
22. Recording requirements.
23. Protection.

D. The Owner's Representative will record significant discussions and agreements and disagreements of each Pre-installation/Construction Conference, and the approved schedule. The Owner's Representative will promptly distribute the record of the Pre-installation/Construction Conference to all attendees.

E. The Construction Manager shall not proceed with the installation/construction if the conference cannot be successfully concluded. The Construction Manager shall be responsible to initiate whatever actions are necessary to resolve impediments to performance of Work and schedule and reconvene another Pre-installation/Construction Conference at the earliest feasible date. Failure of the Construction Manager to resolve impediments to the performance of the work will not result in an extension of days.

1.5 PROGRESS MEETINGS

A. The Owner's Representative will conduct progress meetings, bi-weekly, at the Project Site or at regular intervals as agreed upon at the Pre-construction Conference. The Construction Manager will notify the Owner, the Architect, and the Owner's Representative of the scheduled Progress Meeting dates. Coordinate dates of Progress Meetings with preparation of Application for Payment requests.

B. Attendees: In addition to representatives of the Construction Manager, Owner's Representative, Owner and the Architect, subcontractor, supplier, or other entity concerned with current progress or involved in planning, coordination, or performance of future activities may be requested to attend these meetings on an as needed basis. All participants at the meeting shall be familiar with the Project and authorized to conclude matters relating to the Work. The Construction Manager shall include the site superintendent as a minimum.

C. Agenda: Progress Meetings shall review and correct or approve minutes of the previous Progress Meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to the status of the Project.

1. Construction Schedule or CPM Schedule: Review progress since the last Progress Meeting. Determine where each activity is in relation to the required Construction Manager's "Construction Schedule" or "CPM Schedule" and whether each activity is on time or ahead or behind Schedule. Determine how Work that is behind Schedule will be expedited; secure commitments from parties involved to do so. Discuss whether Schedule revisions are required to insure that current and subsequent activities will be completed within the Contract Time.

2. Review the present and future needs of each entity present, including the following:

a. Interface requirements.

b. Time.

c. Sequences.

d. Status of submittals.

e. Status of RFIs

f. Deliveries.

g. Off-site fabrication problems.

h. Access.

i. Site utilization.

j. Temporary facilities and services.

k. Hours of work.

l. Hazards and risks.

m. Housekeeping.

n. Quality and work standards.

o. Change Orders.

p. Documentation of information for payment requests.

D. Reporting: The Owner's Representative will distribute minutes of the meeting to each party present, within 3 business days of meeting, and to parties who should have been present.

1.6 SUBCONTRACTOR/COORDINATION/SAFETY MEETINGS

A. The Construction Manager shall conduct Subcontractor/coordination meetings.

B. The Construction Manager shall conduct a separate safety meeting after the safety plan is submitted. The Construction Manager shall take meeting minutes. These minutes shall be made available upon request. The Construction Manager shall notify the Owner's Representative of the times and dates of these meetings, who may elect to attend these meetings as an observer when necessary. A minimum of one safety meeting will be held per month.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01 31 19 - CMR

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Construction Documents and general provisions of the CMR Agreement Between Owner and Construction Manager and the Guaranteed Maximum Price (GMP) Amendment, including Division 00 General Conditions of the Contract for Construction – CMR and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for the preparation, submittal, and maintenance of the Construction Manager's computerized progress schedule, reporting progress of the Work, and Contract time adjustments, including the following:

1. Preliminary schedule.
2. Baseline schedule.
3. Two (2) week look ahead schedules.
4. Schedule revisions.
5. Recovery schedules.
6. Narratives.
7. Schedule time extensions.

B. The above listed Project schedules shall be used for evaluating all issues related to time for this Contract. The Project schedules shall be updated in accordance with the requirements of this Section to reflect the actual progress of the Work and the Construction Manager's current plan for the timely completion of the Work. The Project schedules shall be used by the Owner and Construction Manager for the following purposes as well as any other purpose where the issue of time is relevant:

1. To communicate to the Owner the Construction Manager's current plan for carrying out the Work;
2. To identify work paths that are critical to the timely completion of the Work;
3. To identify upcoming activities on the Critical Path(s);
4. To evaluate the best course of action for mitigating the impact of unforeseen events;
5. As the basis for analyzing the time impact of changes in the Work;
6. As a reference in determining the cost associated with increases or decreases in the Work;
7. To identify when submittals will be submitted;
8. To prioritize the review of submittals;
9. To document the actual progress of the Work;
10. To evaluate resource requirements of the Construction Manager and the Owner;
11. To integrate the Work with the operational requirements of the Owner's facilities;
12. To facilitate efforts to complete the Work in a timely manner.
13. To document the history of the Work.

B. Refer to the General Conditions and the Agreement for definitions and specific dates of Contract Time.

C. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 01 Section 01 11 00 "Summary of Work - CMR" specifies the scope of work for the various phases, requirements regarding the Construction Manager's use of premises, occupancy requirements, products ordered in advance, and Owner furnished products.
2. Division 01 Section 01 25 00 "Substitution Procedures - CMR" specifies requirements for handling requests for equals and substitutions.
3. Division 01 Section 01 26 00 "Contract Modification Procedures- CMR" specifies requirements for handling and processing contract modifications.
4. Division 01 Section 01 29 76 "Progress Payment Procedures - CMR" specifies requirements for submitting Schedule of Values and Application for Payments.
5. Division 01 Section 01 31 00 "Project Management and Coordination - CMR" specifies requirements for coordinating construction operations.
6. Division 01 Section 01 31 19 "Project Meetings- CMR" specifies requirements for submitting and distributing meeting and conference minutes.
7. Division 01 Section 01 33 00 "Submittal Procedures - CMR" specifies requirements for submitting the monthly computerized progress schedule.
8. Division 01 Section 01 45 00 "Quality Control - CMR" specifies requirements for submitting inspection and test reports.
9. Division 01 Section 01 50 00 "Temporary Facilities and Controls - CMR" specifies requirements for temporary utilities, support facilities, and security protection.
10. Division 01 Section 01 60 00 "Product Requirements- CMR" specifies requirements for submitting the list of products.
11. Division 01 Section 01 77 00 "Closeout Procedures- CMR" specifies requirements for Contract closeout.

1.3 DEFINITIONS

A. Critical Path Method (CPM): A method of planning and scheduling a construction project where activities are arranged based on activity relationships and network calculations determine when activities can be performed and the critical path of the Project.

B. Critical Path: The longest continuous chain of activities through the network at a given data date for the Schedule to a Contract Milestone or Contract Completion. Where the path to a specific Milestone has become negative, the Critical Path shall be the longest continuous chain of activities with the greatest amount of negative float.

C. Near Critical Path: Any continuous series of activities through the network to the Contract Milestone or the Contract Completion Date where the Total Float of the activity at the data date along that path is within 15 days of the Total Float possessed by the activity at the data date along the Critical Path.

D. Network Diagram: A graphic diagram of a network schedule, showing the activities and activity relationships.

E. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.

1. Critical activities are activities on the critical path.
2. Predecessor activity is an activity that must be completed before a given activity can be started.

F. Event: An event is the starting or ending point of an activity.

G. Milestone: A key or critical point in time for reference or measurement.

H. Float is the measure of leeway in activity performance. Accumulative float time belongs to the Owner.

1. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the following activity.

2. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned project completion date.

I. Total Float: The number of days from the late finish date (LF) to the early finish date (EF) of an activity at a given data date for the Schedule. When the LF is later than the EF, the Total Float shall be positive. When the LF and the EF are the same, the Total Float shall be zero. When the LF is earlier than the EF, the Total Float shall be negative. Unless otherwise specified all references to "float" shall mean "Total Float."

J. Fragnet: The sequence of new activities and/or activity revisions, logic or resource changes that are proposed to be added to the existing schedule to demonstrate the influence of impacts to the schedule. The Fragnet shall identify the predecessors to the new activities and demonstrate the impacts to successor activities.

1.4 QUALITY ASSURANCE

A. Construction Scheduler:

1. The Construction Manager is required to employ or retain the services of an individual skilled in construction scheduling ("Construction Scheduler"). For projects with a Contract value greater than five (5) million dollars, the Construction Scheduler shall have at least five (5) years of verifiable experience as the person primarily responsible for preparing and maintaining detailed project schedules on projects of the same or similar size and nature as this project. The Construction Scheduler is required to attend meetings pertaining to scheduling and progress of the work including all progress meetings.

2. Within five (5) days after the Notice of Award, the Construction Manager shall resubmit the following to the Owner from it's original CMR QBS Submittal Booklet and CMR Proposal:

a. Identification, qualifications, and experience of the Construction Manager's Construction Scheduler and all other members of the Construction Manager's scheduling staff.

b. References of not less than two (2) previous projects on which the Construction Manager's Construction Scheduler has utilized CPM scheduling.

3. The Owner reserves the right to disapprove any Construction Scheduler candidate proposed for the project and/or remove, without rights to work on the project, any member of the Construction Manager's scheduling staff that is, in the Owner's opinion, not qualified. In case of disapproval, the Construction Manager shall resubmit the qualifications and references of the proposed alternate Construction Scheduler within 10 days. The Construction Manager must have its Construction Scheduler approved prior to the issuance of the Notice to Proceed and the submission of any schedule.

4. Should the Construction Scheduler leave the employ of the ~~r~~ Construction Manager or be re-assigned or relieved of his/her responsibilities as the Construction Scheduler on the project, the Construction Manager will be required to submit the qualifications of the proposed replacement Construction Scheduler within 10 days after the date the former Construction Scheduler is no longer responsible for his/her duties on this Project.

B. Scheduling Software:

1. For Contracts greater than five (5) million dollars, the Construction Manager shall use the latest version of Primavera Project Planner as the scheduling software system for use on this Project.

2. The Construction Manager shall provide one (1) licensed copy of the scheduling software to the Owner's Representative for their use, registered in the Owner's name, complete with the entire manufacturer's manual, within five (5) days after the Contract award. The software manuals and license shall become the permanent property of the Owner.

1.5 CPM SCHEDULE FORMAT/CONTENT

A. Format: All Schedules required by this section shall be computer generated, critical path method (CPM) networks utilizing the precedence diagram method of scheduling.

B. Electronic Schedule Naming: The Construction Manager shall not submit any two (2) schedule files with the same file name. File names shall be in accordance with the following requirements:

1. Proposed/Final Preliminary Schedules shall be named P001, P002, P003, etc.
2. Proposed/Final Baseline Schedules shall be named B001, B002, B003, etc.
3. Final Updated Schedules shall be named U001, U002, U003, etc. Any revisions that are required at a particular update on a data date shall be numbered UA01, UB01, UC01, etc.

C. Activity Identification: Each activity in the Project schedules shall have an activity Identifier (activity ID). The Construction Manager is encouraged to utilize the activity ID to contain a structure enabling easy identification of work type, location, subcontractor, etc. The activity ID of an existing activity shall not be modified or assigned to another activity.

D. Activity Description: The activity description shall identify the scope of the activity and shall include a verb or work function (i.e. form, pour, execute, etc.), an object (i.e. slab, footing, wall, etc.), and location (i.e., first floor, roof, etc.). There shall not be any two activities with the same activity description. It shall not be necessary to investigate activity code assignments or logic relationships to identify the scope of an activity. For example, the description "Pour Footing" will not be acceptable. The description "Pour Footing West Wall, Section 2" will be acceptable. The terms "Miscellaneous," "Misc." and other vague adjectives shall not be used in an activity description. The Construction Manager shall standardize the use of terms and their spelling in all activity descriptions. Abbreviation used in activity descriptions shall be consistent with the abbreviations used throughout the Contract Documents and summarized on the Contract Drawings.

E. Work Activities: The Construction Manager shall include activities for work in the following list:

1. Mobilization.
2. All required submittals and submittal review.
3. Equipment and materials procurement/fabrication/delivery.
4. Installing/operating temporary heat and utilities.
5. Preliminary testing of equipment, instrumentation and controls.
6. Final testing, including preparation time.
7. Substantial Completion: Substantial completion activity shall meet all requirements set forth in Division 01 Section 01 77 00 "Closeout Procedures - CMR".
8. Punch list work.
9. Operation and maintenance training.
10. Demobilization.
11. Final cleaning.
12. Issuance of Certificate of Occupancy.
13. Project Specific Issues (If Warranted).

F. Maximum Activity Durations: The Construction Manager shall prepare schedule utilizing activity durations in terms of days. Do not exceed 21 day duration on activities except concrete curing, submittal review and equipment fabrication and deliveries. Where duration of continuous work exceeds 21 days, subdivide activities by location or other sub-element of the work. At the request of the Owner, the Construction Manager shall substantiate the need for specific activities having longer durations than stated herein. If the Construction Manager fails to substantiate this need, then the ~~F~~ Construction Manager shall modify activity durations and the corresponding work scope of the activities to the satisfaction of the Owner.

G. Activity Dates: Early and late start and finish dates of activities shall be calculated for each activity based upon the schedule data date, actual dates, schedule logic, schedule constraints, calendars and original duration or remaining duration, in accordance with the software to calculate incorrect early and late, start and finish dates, the Construction Manager shall be responsible to identify all such errors and to determine correct dates consistent with the parameters specified in this Section.

H. Activity Predecessors and Successors: Every activity shall have logically assigned predecessors and successors in conformance with the requirements of this Section. Unless otherwise specified, Notice to Proceed shall be the only activity in the Project Schedules without a predecessor. Unless otherwise specified, Acceptance and each Contract Milestone(s) shall be the only activity in the Project Schedules without a successor.

I. Activity Constraints: Activity Constraints can affect activity float calculations and shall not be used unless accepted by the Owner. The imposition of a date constraint on any activity shall only be permitted when the Construction Manager demonstrates the need for such a constraint to the satisfaction of the Owner.

J. Imposed Project Finish Date: The imposed project finish date shall be the Contract Completion date, or if the ~~F~~ Construction Manager plans an early completion date, the date it plans to complete the Work.

K. Negative Float: Negative float is calculated when the user imposes a finish date or other constraint on the schedule and when an activity can only finish after its late finish date. The Construction Manager shall remove the imposed finish date and/or constraint causing the negative float when directed to do so by the Owner.

L. Activity Codes: The schedules shall contain activity code classifications and code values. The coding structure shall, at a minimum, include code fields for the following: Phase, Area, Location, Type of Work, Submittal/Procurement, Construction, Responsibility, Original/Extra Work, and Division. All activities in the schedule must have non-blank values for the required codes.

M. Calendars: The planning unit for the Work shall be days. The global calendar shall contain all union holidays. The CMR shall coordinate holidays to be observed with the Owner and incorporate them into the schedule as non-working days. This Calendar shall be a five (5) day work week, Monday through Friday. Every activity shall be assigned a working day calendar based on when the activity is planned to occur and when it is contractually permitted to occur. The CMR shall define and submit additional working day calendars for acceptance by the Owner that are necessary for completion of work in accordance with the requirements of the Contract Documents. Only Owner defined or Owner accepted working day calendars shall be utilized in the Project Schedules.

N. Logic: The CMR shall be responsible for developing the logic of the Preliminary, Baseline and Recovery Schedules and for updating that logic each month to accurately reflect the progress of the Work to-date and the CMR's current plan for the timely completion of the Work.

1. The following criteria shall form the basis for assembly of the schedule logic:

   a. Which activity must be completed before a subsequent activity can be started?

   b. Which activities can be done concurrently?

c. Which activities must be started immediately following a completed activity?

d. What major economic facility or manpower restrictions are required for sequencing these activities?

2. All paths through the Project schedules shall proceed in the direction representing the progression of time. Activity lag duration shall not have a negative value unless the Construction Manager substantiates to the satisfaction of the Owner that this is the best representation of reality. The use of activity lags shall be kept to a minimum. The Construction Manager shall eliminate lags by creating new activities, when the creation of new activities will perform the same function of the lag and when requested to do so by the Owner.

3. Redundant ties to preceding activities in a sequential series of activities will not be permitted. For example, if activity C is the successor in a finish-start relationship to activity B, and activity B is the successor in a finish-start relationship to activity A, then activity A shall not have a redundant finish-start relationship to activity C. A tie representing a different constraint will not be considered redundant. For example, a logic tie showing that the completion of the work scope of a predecessor is required before the successor can start is different from a logic tie representing a resource limitation and will not be considered redundant.

4. The Construction Manager is required to use manpower and equipment restraints, separately noted, to optimize and level manpower and equipment requirements. Such resource leveling shall reflect a reasonable plan for accomplishing the Work. The individual activities involved may be sequenced within the limits of the available Total Float. However, when this leveling technique is used in establishing the initial schedule, it shall be reflected in the logic with restraints identified as "restraint for manpower or equipment leveling purposes only." Critical or near Critical Paths resulting from the use of manpower restraints shall be kept to a minimum.

5. All activities with resource restraints shall be supplemented with resource loading information as noted in Paragraph G.

6. The Construction Manager shall correct all incorrect logic relationships in the Schedule Updates to eliminate any out-of-sequenced logic. The Construction Manager shall make all changes in the logic or other adjustments found to be incorrect by the Owner.

O. Progress Data: Actual start and finish dates shall not be automatically updated by default mechanisms that may be included in the CPM scheduling software systems. The primary source of actual starts and finishes and period percentage completes shall be by field verification. The Construction Manager is to insure that progress is based of a current estimate of remaining duration to complete the Work and not the activity percent complete which calculates the remaining duration based on the original estimated duration.

P. Submittals:

1. Each submission that is required by the Contract Documents shall have a corresponding activity, for the preparation and review and approval at the submission. When the Construction Manager plans on making a submission in parts, each part of the submission shall have corresponding preparation and review and approval activities.

2. The timing, sequencing and duration of all submitted review and approval activities shall be in accordance with the Contract Documents.

3. All submissions designated "Revise and Resubmit" shall require that the Construction Manager insert new submittal preparation and review and approved activities with appropriate logic into the schedule.

4. When submittal receives a partial approval and the partial approval is sufficient to enable the commencement of a successor activity, then the original submittal activity shall be

broken down into multiple activities as necessary to accurately reflect the logic of the Construction Manager's current plan.

5. When multiple items are included in a single submittal, the "Review and Approve" activity for the submittal shall be a predecessor to every activity representing the fabrication and delivery of any of the materials.

Q. Delivery Activities: The schedules shall include activities for all fabrication and delivery work except for short lead time items. "Short lead time" shall be defined as a period of fourteen (14) days or less from placement of order to delivery of material to the project site. Activities representing the delivery of materials or equipment for more than one (1) installation activity will permitted in accordance with the following conditions.

1. The material delivery activity shall be a predecessor to the first activity representing the installation of the material in each area.
2. When partial deliveries are received and those deliveries are adequate to enable the commencement of some, but not all, successor activities, then the original delivery activity shall be broken down into multiple activities as necessary to accurately reflect the logic of the Construction Manager's current plan.

R. Inspections/Testing: The Construction Manager shall include an activity for each inspection and test required by the various officials and agencies, including the Building Inspector, and Fire Marshall. The Construction Manager shall schedule these activities in accordance with the availability of the corresponding agency/official.

S. Progress Override/Retained Logic: The Construction Manager shall use retained logic to calculate all schedules required by this section. The use of progress override is not allowed without prior approval of the Owner.

T. Weather Days Allowance: The Construction Manager shall include as a separate identifiable activity on the Critical Path, and activity labeled "Weather Days Allowance." Insert this activity immediately prior to the Substantial Completion Milestone.

1. The CMR shall be fully responsible for determining the number of weather delay days to be included in the CPM Schedule. This determination shall be based on the normal anticipated weather for the Project location and the nature of the Project work. The CPM Schedule shall be based on the CMR's determined weather delay allowance.

2. The minimum allowed duration of the Weather Days Allowance shall be calculated as follows (decimals rounded to nearest whole number):

$$\frac{\text{Contract Time (Calendar Days)}}{365} \quad \text{multiplied by} \quad 7 \quad \text{equals} \quad \text{Weather Days Allowance (Calendar Days)}$$

3. The CMR shall insert an activity in the Critical Path to reflect weather day occurrences when weather days are experienced and accepted by the Owner. Identify this activity as a weather delay.

4. The Construction Manager shall reduce duration of Weather Days Allowance activity as weather delays are experienced and inserted into the schedule. Remaining weather days in Weather Day Allowance at completion of project is considered float. Weather delay, when justified, are considered allowable, non compensable.

U. Regulatory/Third Party Approvals: The Construction Manager shall include activities in its schedule for all approvals required by regulatory agencies or other third parties.

V. Resource Loading: The Construction Manager shall resource load the schedules when required by this Specification and/or if requested to do so by the Owner. When required, the schedules shall be resource loaded for both the Construction Manager and all of its subcontractors as detailed below or as otherwise directed by the Owner. The Construction

Manager may propose additional or alternative resource loading for the Owner review and acceptance. Defining a resource shall consist of identifying the resource name, resource description, unit of measure, and calendar assignment.

1. Labor Resources: Labor shall refer to all craft labor including foreman. Labor shall be measured in person-days. The labor resource definitions shall be consistent with the subcontractor work scope.
2. Construction Equipment Resources: The planned use of equipment requiring a licensed operator shall be reflected in equipment resource assignments to activities.
3. Limits on Resources: The Construction Manager shall indicate in its Narrative the expected amount of resource and shall define the normal or expected usage along with a maximum limit available to the Construction Manager. Resource limits may vary for different stages of the work. Resource limits shall be revised to reflect the Construction Manager's current plan for the timely completion of the work.

W. Activity Logs:

1. Activities that are modified or added by change order shall be identified in the activity log. The change order number, as issued by the Owner, and the date the activity was modified or added shall be clearly recorded.
2. Activities affected by logic changes, resource changes, duration changes and calendar changes shall be identified in the activity log. The date the activity was modified, the nature of the change and the reason for the change shall be clearly recorded.

1.6 PRELIMINARY SCHEDULE AND PRELIMINARY SCHEDULE UPDATES

A. For projects with a construction cost estimate over five (5) million dollars, the Construction Manager shall submit a Preliminary Schedule and Preliminary Schedule Updates. The Notice to Proceed will not be issued and the Construction Manager will not be allowed to start work at the Project site until the Preliminary Schedule has been submitted and accepted.

B. The Preliminary Schedule shall contain a detailed plan of operations for the first 90 days of Work after receipt of the Notice to Proceed.

C. The Architect and CTDCS PM and Construction Manager shall meet after receipt of Preliminary Schedule to review and make necessary adjustments Construction Manager shall submit a revise Preliminary Schedule incorporating the adjustments with five (5) days after meeting.

D. All Work contemplated beyond the first ninety (90) days shall be shown in sufficient detail such that the Critical Path and all Contract Milestones may be identified.

E. The Preliminary Schedule shall be updated monthly during first ninety (90) days after issuance of the Notice to Proceed. The first update of the Preliminary Schedule shall show the progress on the actual Notice to Proceed date and shall be submitted to the Owner's Representative within five (5) days after the issuance of the Notice to Proceed. Subsequent updates shall show the progress through the last day of the month and shall be submitted to the Architect and CTDCS PM by the fifth business day of each month.

F. Preliminary Schedule Update revisions that are required as a result of review comments by the Architect and CTDCS PM shall be submitted within five (5) days of the Construction Manager's receipt of the Architect and CTDCS PM comments. The data date of the revised Preliminary Schedule Update shall remain on the first day of the month.

G. The Construction Manager shall not be permitted to make any schedule revisions (besides progress) to the Preliminary Schedule Update unless approved by the Architect and CTDCS PM. When schedule revisions are required, the Construction Manager shall submit a Schedule Revision per Article 1.11.

1.7 BASELINE SCHEDULE

A. For projects with a construction cost estimate over five (5) million dollars, the Construction Manager shall submit the proposed Baseline Schedule to the Owner's Representative Architect and CTDCS PM for all the work of the project within 45 days after issuance of the Notice to Proceed. The Accepted Preliminary Schedule shall be incorporated unchanged, as first 90 days activity in the Construction Manager's Baseline Schedule.

B. The proposed Baseline Schedule shall show sequence and interdependence of all activities required for complete performance of all Work, beginning with date of Notice to Proceed and concluding with date of final completion of the Contract. The Baseline Schedule shall depict the work as bid and as planned as of the Notice to Proceed. The data date shall be the actual date of the Notice to Proceed.

C. The Owner's Representative and the Construction Manager shall meet after the Owner's Representative's receipt of the Baseline Schedule to review and make necessary adjustments. Should adjustments be required, the Construction Manager shall submit a revised Baseline Schedule within five (5) days after the meeting and receipt of the Architect and CTDCS PM comments. Subsequent follow-up meetings and resubmissions may continue until the Architect and CTDCS PM accepts the Baseline Schedule.

D. The Construction Manager shall require each major Trade Contractor and major supplier to submit in writing a statement certifying that the major Trade Contractor or major supplier has concurred with the Construction Manager's Baseline Schedule, the major Trade Contractor's or major supplier's related schedule has been incorporated accurately, including the duration of activities and crew allocations. The definition of a "major Trade Contractor" is one (1) that provides services valued in excess of five (5) percent of the Contract value. The definition of "major supplier" is one (1) that provides material(s) or services valued in excess of one (1) percent of the Contract value. Failure of the Construction Manager to provide the required information will delay the approval of the Baseline Schedule.

1.8 SCHEDULE UPDATES

A. The Construction Manager shall update and progress the CPM Schedule through the last day of each month (the Data Date is the first day of the month). Updating and progressing the CPM Schedule shall be completed and submitted by the fifth business day each month. Except as otherwise authorized by the Owner's Representative, monthly submissions received after the due date are considered late.

B. The first update will consist of the approved Baseline Schedule updated as of the first day of the first month which starts after 90 days from the Notice to Proceed. Subsequent monthly Schedule Updates will be the previous month's approved Schedule Update or approved Revision Schedule updated to reflect progress over the last month. Schedule revisions, apart from updating the status of the remaining durations and percent completes of the various work activities will not be permitted in the Schedule Update.

C. The Construction Manager shall create a copy of the previous month Schedule Update for the purpose of updating and progressing it. The schedule shall be updated to show the work actually accomplished during the preceding month, the actual time consumed for each activity, and the estimated time remaining for any activity that has been started but not completed. The updating of the percent complete and the remaining duration of any activity shall be independent functions; program features that calculate one of these parameters from the other shall be disabled.

D. The Construction Manager shall make the necessary adjustments to the Schedule Update in accordance with the Owner's Representative's Schedule Update review comments and shall re-submit the Schedule Update within five (5) days after receipt of those comments.

E. The Construction Manager shall prepare the monthly Schedule Updates every month starting on the month described above through the actual substantial completion date.

1.9 TWO-WEEK LOOK AHEAD SCHEDULES

A. The Construction Manager shall be required to produce and submit to the Owner's Representative a Two-Week Look Ahead Schedule, to be updated and submitted the first day of each week. Except as otherwise authorized by the Owner, submissions received after the due date are considered late.

B. The Two-Week Look Ahead Schedule may be a CPM schedule or a bar chart; it shall be consistent with the previously approved Schedule Update or approved Schedule Revision.

1.10 SCHEDULE REVISIONS

A. If, at any time, the Construction Manager alters its logic, original durations, or descriptions, adds activities or activity codes, or in any way modifies the accepted Preliminary Schedule, accepted Preliminary Schedule Update, Baseline Schedule or Schedule Update, the Construction Manager must notify the Owner's Representative of the change(s), in writing and submit a Revision Schedule to the Owner's Representative for review.

B. The preparation and submission of Revision Schedules will also be required to reflect any Contract Modifications that were approved and Construction Change Directives that were issued during the preceding period and any extra or changed work that the Construction Manager has started during the preceding period.

C. With each Revision Schedule, the Construction Manager shall submit a written narrative explaining the nature of the change(s), the schedule, the reason for the change(s) and the impact on the schedule as a result of the change(s).

D. All changes (i.e. duration changes, logic changes, new logic, new or modified activities changes in work sequence, etc.) shall be recorded and a note added to the activity log. The record shall include at a minimum, the date and the reason for the change, and description of the change.

E. The required Revisions Schedules and Narratives are in addition to the regular Schedule Update. They shall be separate submittals and shall be noted as Schedule Revisions.

F. Proposed Revision Schedules shall be submitted by the fifth day of the month and shall reflect status as of the first day of the month.

G. The Owner's Representative and Construction Manager shall meet after the Owner's Representative's receipt of the Revision Schedule and Narrative to review and make necessary adjustments. Should adjustments be required, the Construction Manager shall submit a revised Revision Schedule to the Owner's Representative within five (5) days after the meeting and receipt of the Owner's Representative Comments. Subsequent follow-up meetings and resubmissions may continue until after the Owner's Representative accepts the Revision Schedule.

H. Only upon acceptance of a revision to the Schedule by the Owner's Representative shall the revision be reflected in the next Schedule Update and Two-Week Look-Ahead Schedule.

I. The Owner's Representative reserves the right to accept or reject any schedule revisions proposed by the Construction Manager.

1.11 RECOVERY SCHEDULES

A. If, in opinion of the Owner, a Schedule Update indicates that the Construction Manager has fallen behind schedule, or that a revision in sequence or operations may be necessary for any other reason, the Construction Manager shall within seven (7) days of receiving a written request to perform "Recovery" from the Owner's Representative, immediately institute all necessary steps to improve his progress and shall submit such revised network diagrams, tabulations, operational plans and any supplementary information, as may be deemed necessary by the Owner, to demonstrate the manner in which an acceptance rate of progress will be regained.

B. Should the Construction Manager's "Recovery" efforts not demonstrate an ability to regain an acceptable rate of progress, Owner's Representative may require the development of a "Recovery Schedule" and the Construction Manager shall submit the Recovery Schedule within seven (7) days of receiving a written request for the Recovery Schedule from the Owner's Representative. The Recovery Schedule is to be supplemented with resource allocations for every task activity and include time-scaled resource histograms. The resource allocations shall be shown to a level of detail that facilitates report generations based on labor crafts and equipment classes for the Construction Manager and Trade Contractors. The Construction Manager shall use average composite crews to display the labor loading of onsite construction activities. The Construction Manager shall optimize and level labor to reflect a reasonable plan for accomplishing the Work of the Contract and to assure that resources are not over allocated in multiple concurrent activities. The time-scaled resource histograms shall show labor crafts and equipment classes to be utilized on the Contract.

C. In addition to required submittals, the "Recovery Schedule" submission will also include a Narrative as detailed herein, a time-scaled resource histogram and a Monthly Resources Loading Summary Report (tabular) indicating the peak number of resources required for each activity.

D. The Owner's Representative shall be the sole judge as to whether the Recovery Schedule is sufficiently detailed. Upon acceptance of this Recovery Schedule, it shall form the basis of the new Monthly Schedule Updates going forward.

E. No additional compensation will be allowed for Recovery Schedules required to overcome delays caused in whole or in part by the Construction Manager.

1.12 NARRATIVES

A. The Construction Manager shall prepare and submit a Narrative to accompany the Baseline Schedule, Preliminary Schedule and each Preliminary Schedule Update and Monthly Schedule Update. The Narratives shall include:

1. Identification of the update period, the data date and the schedule file name.
2. A description of the current Critical and Near Critical Paths activities that are supposed to start or to be worked on over the coming month.
3. Changes to the Critical Path, intermediate and completion Milestones
4. Description of problem areas.
5. Current or anticipated delays:
   a. Cause of delay.
   b. Impact of delay on other activities, Milestones, and completion dates.
   c. Corrective action and schedule adjustments to correct the delay.
6. A discussion of work completed during the period.
7. A comparison of the planned versus schedule progress early on and near Critical Path activities that were to have been worked on over the last month.
8. A description of any interdependencies between the Construction Manager's Schedule and any work by other Contractors, third parties, and/or the Owner and its representatives.
9. A description of the current status of float created by any previous or ongoing compensable or excusable delays, whether or not the Construction Manager has utilized any of this float over the last period by purposefully slowing down (pacing) and any request to utilize this float over the coming period.
10. An explanation of how adverse weather has been addressed in Schedule and an accounting of the Weather Day Allowance delineating the activities incorporated into the

Schedule to account of work days lost due to weather and the resultant decrease in the duration of the Weather Day Allowance.

11. A description of planned labor resources to be utilized to complete critical and near Critical Path work as requested by the Owner's Representative.
12. A description of actual and potential equipment resource limitations.

1.13 NETWORK FILES, GRAPHICAL OUTPUT AND REPORTS

A. With each Preliminary Schedule, Preliminary Schedule Update, Baseline Schedule, Schedule Update, Revision Schedule and Recovery Schedule required by these specifications, the Construction Manager shall submit to the Owner's Representative the following schedule reports/graphics/files:

1. Three (3) compact disc sets that each include:

a. A compressed back up of the entire schedule.

b. Gantt charts in Adobe Acrobat PDF file format, formatted to fit ANSI Size D paper (610mm x 914mm) (24" x 36"), and showing the Activity ID, Activity Description, Original Duration, Remaining Duration, Total Float, Early Start and Finish Dates, and Calendar ID. Types of Gantt Charts to be included are:

i. The project critical (longest) path.

ii. The Project near Critical Path (excluding Critical Path activities).

iii. All uncompleted work activities as of the data date.

2. Reports in Adobe Acrobat PDF file format, formatted to fit 216mm x 279mm (8½" x 11") size paper, to include:

a. A listing of all activities, by activity code, with early & late starts and Total Float.

b. A Claim Digger Report that details all changes between the current schedule submittal and the previous month's update submittal.

c. Detailed Predecessor/Successor Report which included a listing of all activities that immediately precede and immediately succeed that activity in the schedule logic.

3. Three (3) paper copies of each Gantt Charts in color and report on the paper size specified above.

B. Schedule submittals will only be considered complete when all materials have been submitted.

1.14 FLOAT/CRITICAL PATH

A. With the exception of the Float described in Paragraphs B and C, Float is not for the exclusive use or benefit of either the Owner's Representative or the Construction Manager but is an expiring resource available to all parties acting in good faith as needed to meet any Contract Milestone(s).

B. As float is an expiring resource, if the Work is delayed on the Critical Path due to an excusable delay (either compensable or non-compensable) or by any delay for which responsibility has not yet been agreed upon, the Construction Manager may not use any float created by such delay on any other path without the express written approval of the Owner's Representative or unless at the time of the float consumption a time extension had been issued for the delay that created the float being consumed. Use of such float on any parallel path without the approval of the Owner's Representative shall be construed as a concurrent inexcusable delay to any delay caused by the Owner's Representative.

C. It is acknowledged and agreed by the Construction Manager that Owner's Representative caused delays on the project may be offset by Owner's Representative caused time savings

(including, but not limited to: Critical Path submittals returned in less time than allowed for in the Contract, approval of substitution requests which result in a savings of time along the Critical Path for the Construction Manager, etc.). In such an event, the Construction Manager shall not be entitled to receive an extension of time or delay damages until the Owner's Representative caused time savings are exceeded and the Contract completion date also exceeded.

1.15 EARLY COMPLETION

A. Should Construction Manager submit a Preliminary Schedule, Baseline Schedule, Schedule Update or Schedule Revision showing Project Completion more than twenty-eight (28) days prior to Contract Completion Date, the Owner's Representative may issue a Change Order, at no cost to Owner, revising the time of performance of Work and Contract completion date to match Construction Manager's schedule. Contract Milestone dates, if any, shall be adjusted accordingly. The assessment of liquidated damages shall be measured based on the new Milestone and Contract completion dates.

B. Should any monthly Schedule Update show the project completion earlier than current Contract completion date, the Construction Manager shall show early completion time as schedule activity, identified as "Project Float." This float shall be available for use by either party as per the provisions of this subsection 1.14 - Float/Critical Path. The Owner shall not liable for any damages as a result of utilizing this float.

1.16 CONTRACT TIME EXTENSIONS

A. Mitigation of Delays:

1. The General shall be responsible to develop mitigation measures for all delays regardless of responsibility for the delays and to identify all time and cost impacts to the work associated with those mitigation measures. Unless circumstances otherwise require, the General Float/Critical Path shall not pursue mitigation action for which it expects the Owner to be liable prior to notifying the Owner and receiving Owner's Representative authorization to proceed with the mitigation action. Any action taken by the Construction Manager prior to receiving approval from the Owner's Representative shall be at the Construction Manager's risk.

2. When the need for mitigation arises to ensure timely completion, the Construction Manager shall review all uncompleted activities on the Critical and Near Critical Paths to the Contract Completion Date for errors in scope, duration, and logic and for the feasibility of performing in parallel work currently scheduled sequentially.

3. Whenever it is possible for the Construction Manager to mitigate delay without added cost, the Construction Manager shall do so. The Construction Manager shall mitigate all delays as efficiently and economically as possible, with the objective of minimizing both the time and cost impact of the delay regardless of responsibility for the delay. The Owner will not be liable for damages which the Construction Manager could have avoided by reasonable means such as prudent scheduling of the work and judicious handling of forces, equipment or plant. The Owner will not be liable for damages incurred by the Construction Manager during any period of time when the Construction Manager has failed to provide notification of delay in accordance with the Contract requirements when having the notification at the specified time could have influenced the Owner's decision or actions.

B. Time Impact Analysis:

1. If the Construction Manager believes that a proposed change will impact the Project Completion Date or interim Milestones, the Construction Manager shall submit an analysis with its Change Order Proposal demonstrating the delay to the Critical Path. This analysis shall be in the form of a Time Impact Analysis (TIA).

2. The Time Impact Analysis shall consist of: 1) a Fragnet of the portion of the schedule that will be affected by the incorporation of the change, which shall include the new activities, revised logic and durations associated with the proposal change; 2) a narrative explanation of how the proposed change would impact the schedule; 3) an impact schedule which shall be developed by incorporating the Fragnet and required changes, including any delay mitigation measures, into the most recent accepted schedule update and; 4) electronic copies of the Fragnet and impact schedule.
3. The Construction Manager shall submit its TIA in sufficient time to allow it to be incorporated into a Revision Schedule prior to the change order work proceeding, allowing the Owner thirty (30) days after receipt of the TIA and all the supporting information required with the Change Order Proposal to approve or reject the analysis.
4. Upon agreement on the schedule impact due to the proposed change and the issuance of a time extension, the Construction Manager shall incorporate the agreed upon Fragnet/schedule revisions in the next monthly update.
5. The Owner reserves the right to have the Construction Manager proceed with the change order related work without agreeing on the time associated with it and to measure the actual schedule impact via Contemporaneous Period Analysis.
6. In cases where the Construction Manager has not submitted a TIA with its Change Order Proposal for a particular proposed change, the Construction Manager agrees that the particular proposed change has no impact on the Contract Completion Date or interim Milestones and no time extension is required.

C. Contemporaneous Period Analysis:

1. When an accepted Schedule Update indicates the project has been delayed beyond the current Contract Completion Date and the Construction Manager believes it is entitled to an extension of time, the Construction Manager shall prepare and submit to the Owner a Contemporaneous Period Analysis (CPA) demonstrating the delay(s) to the Critical Path at the time of the delay, mitigation measures taken or proposed by the Construction Manager and request an extension of time.
2. The Construction Manager's CPA and time extension request shall be submitted prior to the submission of the next Schedule Update.
3. The request shall indicate the amount of time requested, the period when the delay was experienced and an explanation as to the cause of the delay.
4. The CPA shall quantify the delay by comparing the completion dates and Milestone dates on an update by update basis, starting with the update just prior to the delaying event and ending with the update just after the conclusion of the delaying event. Only the accepted schedules/Schedule Updates shall be used in the CPA. The CPA shall determine the cause of the delay by correlating slippage with various unforeseen events.
5. The CPA will consist of: 1) an update by update accounting of all delay(s) during the period in question; 2) an update by update narrative explanation of how the delay(s) affected the completion date or would have affected the completion date but for other concurrent delay(s); 3) chronologies of the issues affecting the schedule period in question; and 4) a day by day accounting and description of the unanticipated work/work stoppage on the Critical Path and/or path in question; 5) a Gantt chart comparing the as-planned schedule just prior to the start of the delay to the actual as-built for the path(s) in question.

D. The Owner may require the Construction Manager to correct errors in its TIA or CPA at anytime, whether or not the schedules have been accepted and/or time extension issued and agreed upon. Should the errors affect the outcome of the TIA or CPA, the Owner reserves the right to adjust the time extension accordingly. Generally, a schedule will be found to be in error if it does not properly reflect the sequencing, timing and durations of all the work and

required events as well as mitigation efforts contemplated or which should have been contemplated at the time of the data date of the schedule.

E. Time Extensions will be granted only to the extent that equitable adjustments for the activity or activities affected exceed or exceeded the total or remaining float along the Critical path or activities at the time of the actual delay. Actual delays in activities which do not affect the Critical Path work or which do not move the Construction Manager's planned completion date beyond the Contract completion date or current completion date as affected by previous delays, will not be the basis for an adjustment to the Contract time. Time Extensions shall not be granted until a delay occurs that is:

1. Beyond control of and without fault of or negligence of the Construction Manager and the major Trade Contractors or Suppliers at any time.
2. Extends the actual performance of the work beyond the Contract completion date or other specified Interim Milestones.

E. Should a non-compensable excusable delay be concurrent with one or more compensable delays, the Construction Manager and Owner agree that the net result is a non-compensable, excusable delay to the extent the delay is caused by the non-compensable event.

F. The Construction Manager shall have no claim for damages of any kind, or extensions or increase to the Contract time(s) or Contract Milestone(s), or adjustments of Contract Price on account of any delay, interruption or suspension of the Work or any portion thereof (herein after collectively referred to as "Delay"), due to whatever cause unless the prerequisites of this Subsection are met. The requirements of this Subsection are in addition to and not in lieu of the requirements of any other applicable subsection.

1.17 REVIEW AND ACCEPTANCE OF PROJECT SCHEDULE SUBMITTALS

A. The Owner's Representative shall review schedule submittals for conformance with the requirements of the Contract Documents. Schedule review comments by the Owner's Representative may address whether items of Work are omitted, activity durations are reasonable or that the level of labor, materials, and equipment, the means, methods, timing, and sequencing of the Work are practicable. The planning, scheduling or execution of the Work and the accuracy of any Project Schedule shall remain the sole responsibility of the Construction Manager.

B. During the review of any of the submissions required by this section, if any of the following conditions are discovered the submittal shall be returned by the Owner's Representative without further review for correction and re-submittal:

1. The submittal is incomplete.
2. The submittal does not comply with the specified format.
3. A component of the submittal has not been prepared in accordance with all of the requirements of this section.
4. The quality of the submittal indicates that the Construction Manager has failed to perform an internal quality control review prior to submission.
5. There is an inconsistency between electronic files and printed material.

C. It is the Construction Manager's responsibility to ensure that all Project Schedules are in compliance with all of the requirements of the Contract Documents. The Owner's Representative's failure to return a submittal shall not be construed to mean that the submittal is in compliance with the requirements of the Contract Documents. The Owner's Representative, at its discretion, may choose to complete a submittal review even though the submittal fails to meet one of more of the conditions for rejection stated herein.

D. The acceptance of any Project Schedule by the Owner's Representative does not constitute acceptance or approval of any change to the requirements of the Contract Documents

including but not limited to any mandated construction sequences. The Owner's Representative is not responsible for any erroneous assumptions or information in any Project Schedules regardless of origin.

E. The Construction Manager shall be responsible for all delays due to its failure to submit complete submittals in accordance with the requirements of the Contract Documents.

F. The Schedule submitted will not be considered acceptable until all of the Owner's Representative's comments are incorporated into the schedule to the Owner's Representative's satisfaction.

G. Errors in any Project Schedule accepted by the Owner's Representative, including but not limited to activity durations, relationships between activities, resource allocation or other float suppression techniques that do not accurately reflect the work may be identified at any time and once identified shall be corrected by the Construction Manager.

H. Owner's Representative's acceptance of a Schedule Update shall not constitute the approval of a time extension should the Project Completion Date or Contract Milestone(s) be shown as delayed.

I. Notwithstanding any review, review comments, acceptance, scheduling assistance or direction to change an/or revise any schedule by the Owner's Representative, the schedules shall at all times be the Construction Manager's schedule for performing the Work and not be considered as any Owner's Representative direction constituting a change unless the Construction Manager gives appropriate notice and the other Contract provisions for determining merit and entitlement are met.

1.18 PAYMENT

A. When the Construction Manager submits its schedule of values in accordance with the General Conditions, it shall include a amount for the scheduling work associated with this section, this cost to be paid in accordance with Division 01, Section 01 29 76 Progress Payment Procedures - CMR.

B. Failure of the Construction Manager to submit a Baseline Schedule or Revised Baseline Schedule for any portion of the work in accordance with t his specification may result in the withholding all Contract payment until the schedule is submitted to, and accepted for compliance with the specification and reasonableness, by the Owner's Representative.

C. In the event the project extends beyond the original completion date by more than 30 days, and a time extension is granted to the Construction Manager, the Owner's Representative may require additional CPM updates which will be paid at the per month cost for the Scheduling Update services.

1.19 DISTRIBUTION

A. Distribute copies of the computer generated schedules to Owner's Representative, Architect, Owner, Subcontractors, suppliers, and other concerned parties.

B. Instruct recipients to promptly report, in writing, problem anticipated by projections indicated in schedules.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01 32 16.13 - CMR

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Construction Documents and general provisions of the CMR Agreement Between Owner and Construction Manager and the Guaranteed Maximum Price (GMP) Amendment, including Division 00 General Conditions of the Contract for Construction – CMR and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for construction photographs.

B. Related Sections: The following Section contains requirements that relate to construction photographs:

1. Division 01 Section 01 33 00 "Submittal Procedures - CMR" specifies general requirements for submitting digital construction photographs.

1.3 SUBMITTALS

A. Photographs: Provide a digital camera to take twenty-four (24) or more digital photos each time. Deliver two (2) sets of photo files on CD-ROM and one (1) set of prints (8x10) to the Owner's Representative for the Department.

B. Extra Sets: When requested by the Owner, the photographer shall prepare extra sets of prints or CD-ROMs. The photographer shall distribute these directly to the designated parties who will pay the costs for the extra sets directly to the photographer.

1.4 QUALITY ASSURANCE

A. Engage a qualified commercial photographer to take photographs during construction.

B. Photographer's Qualifications: Photographer shall be an individual of established reputation who has been regularly engaged as a professional photographer for not less than three (3) years.

PART 2 - PRODUCTS

2.1 PHOTOGRAPHIC COPIES

A. On the date the work is begun and every thirty (30) Calendar Days thereafter (until the work is at least 95 percent complete), the Construction Manager shall have digital photographs of the construction taken by a professional photographer.

B. Identification: Label each CD-ROM with project name and date the photographs were taken. With each submittal provide an applied label, rubber-stamped or index sheet with the following information:

1. Name of the Project.

2. Name and address of the photographer.

3. Name of the Architect.

4. Name of the Construction Manager.

5. Date the photographs were taken.

6. Vantage Point: Description of vantage point, in terms of location, direction (by compass point), and elevation or story of construction.

PART 3 – EXECUTION

3.1 PRECONSTRUCTION PHOTOGRAPHS

A. Before starting construction, take digital photos of the site and surrounding properties from different points of view, as selected by the Architect and CTDCS PM and Owner's Representative.

1. Take digital photos in sufficient number to show existing site conditions before starting Work.

2. Take digital photos of adjacent existing buildings either on or adjoining the property in sufficient detail to record accurately the physical conditions at the start of construction.

3.2 PHOTOGRAPHIC REQUIREMENTS

A. Take twenty-four (24) or more digital photographs monthly, coinciding with the cutoff date associated with each Application for Payment. The Architect and CTDCS PM and Owner's Representative shall select the vantage points for each shot to best show the status of construction and progress since the last photos were taken.

B. As the digital photographs are a record of the work progress, they shall be taken each month, whether or not they show work done during the preceding month. Deliver the CD-ROMs and prints within ten (10) Calendar days of their taking.

C. Provide and coordinate the use of photographic software to assure that the photos are viewable by all interested parties.

END OF SECTION 01 32 33 - CMR

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Construction Documents and general provisions of the CMR Agreement Between Owner and Construction Manager and the Guaranteed Maximum Price (GMP) Amendment, including Division 00 General Conditions of the Contract for Construction – CMR and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for submittals required for performance of the Work, including but not limited to the following:

1. Submittal schedule.
2. Shop Drawings.
3. Product Data.
4. Samples.
5. Quality assurance submittals.
6. Proposed "Substitutions/Equals".
7. Warrantee samples.
8. Coordination Drawings.
9. O & M Manuals

B. Administrative Submittals: Refer to other Division 01 Sections and other Contract Documents for requirements for administrative submittals. Such submittals include, but are not limited to, the following:

1. Permits.
2. Applications for Payment.
3. Performance and payment bonds.
4. Construction Manager's Construction Schedule or CPM Schedule.
5. Daily construction reports.
6. Construction Photographs.
7. Insurance certificates.
8. List of subcontractors.
9. Subcontractors/Suppliers FEIN number's and Connecticut tax registration number.

C. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 01 Section 01 25 00 "Substitution Procedures - CMR" specifies requirements for submittal of requests for equals and substitutions.

2. Division 01 Section 01 29 76 "Progress Payment Procedure- CMR s" specifies requirements for submittal of the Schedule of Values.

3. Division 01 Section 01 31 00 "Project Management and Coordination- CMR" specifies requirements governing preparation and submittal of required Coordination Drawings.

4. Division 01 Section 01 31 19 "Project Meetings- CMR" specifies requirements for submittal and distribution of meeting and conference minutes.

5. Division 01 Section 01 32 16.13 "CPM Schedules- CMR" for requirements for CPM scheduling and reporting progress of work.

6. Division 01 Section 01 32 33 "Photographic Documentation- CMR" specifies requirements for submittal of periodic construction photographs.

7. Division 01 Section 01 35 26 “Government Safety Requirements- CMR” specifies the requirements for safety plans, reports, and investigation submittals.

8. Division 01 Section 01 45 00 "Quality Control- CMR" specifies requirements for submittal of inspection and test reports and mockups.

9. Division 01 Section 01 45 23.13 "Testing for Indoor Air Quality (IAQ), Baseline IAQ, and Materials- CMR " specifies requirements for submittal of documentation required to support LEED or Green Globes certification.

10. Division 01 Section 01 77 00 "Closeout Procedures- CMR "specifies requirements for submittal of Project Record Documents and warranties at project closeout.

11. Division 01 Section 01 78 30 "Warranties and Bonds- CMR".

12. Division 01 Section 01 81 13 "Sustainable Design Requirements- CMR" specifies requirements for submittal of documentation required to support LEED or Green Globes certification.

13. Division 01 Section 01 91 00 "Commissioning- CMR" specifies requirements for submittal of quality assurance documentation related to commissioning.

1.3 DEFINITIONS

A. Coordination Drawings show the relationship and integration of different construction elements that require careful coordination during fabrication or installation to fit in the space provided or to function as intended and as identified in the Specification Divisions 02 through 49.

1. Preparation of Coordination Drawings is specified in Division 01 Section 01 31 00 "Project Management and Coordination-CMR" and may include components previously shown in detail on Shop Drawings or Product Data.

B. Field samples are full-size physical examples erected on-site to illustrate finishes, coatings, or finish materials. Field samples are used to establish the standard by which the Work will be judged.

C. Mockups are full-size assemblies for review of construction, coordination, testing, or operation; they are not Samples.

1.4 SUBMITTAL PROCEDURES

A. Coordination: Coordinate preparation and processing of submittals with performance of construction activities. Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.

2. Coordinate transmittal of different types of submittals for related elements of the Work so processing will not be delayed by the need to review submittals concurrently for coordination.

a. The Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until all related submittals are received.

b. The Architect reserves the right to reject incomplete submitted packages.

3. Processing: To avoid the need to delay installation as a result of the time required to process submittals, allow sufficient time for submittal review, including time for re-submittals.

a. Allow fifteen (15) Calendar Days for initial review. Allow additional time if the Architect must delay processing to permit coordination with subsequent submittals.

b. If an intermediate submittal is necessary, process the same as the initial submittal.

c. Allow fifteen (15) Calendar Days for reprocessing each submittal.

d. No extension of Contract Time will be authorized because of failure to transmit submittals to the Architect sufficiently in advance of the Work to permit processing.

B. Submittal Preparation: Place a permanent label, title block or 8-1/2 inches x 11 inches cover page approved by the Architect, on each submittal for identification. Indicate the name of the entity that prepared each submittal on the label or title block.

1. The minimum number of copies required for each submittal shall be seven (7) or as determined otherwise at the pre-construction conference or by the Construction Administrator.

2. Provide a space approximately 4 inches by 5 inches on the label, beside the title block or on the cover page on Shop Drawings to record the Construction Manager's review and approval markings and the action taken.

3. Include the following information on the label for processing and recording action taken.

a. Project Name and State of Connecticut Project Number.

b. Date.

c. Name and address of the Architect, Construction Administrator, and Owner Representative.

d. Name and address of the Construction Manager.

e. Name and address of the subcontractor.

f. Name and address of the supplier.

g. Name of the manufacturer.

h. Number and title of appropriate Specification Section.

i. Drawing number and detail references, as appropriate.

j. Indicate either initial or resubmittal.

k. Indicate deviations from Contract Documents.

l. Indicate if "equal" or "substitution".

C. Submittal Transmittal: Package each submittal appropriately for transmittal and handling. Transmit each submittal from the Construction Manager to the Architect using a transmittal form. Copy the Construction Administrator on the transmittal. The Architect will return all submittals to the Construction Manager after action is taken with a complete copy of the submittal package and one complete copy of the submittal package. The Architect will not accept submittals received from sources other than the Construction Manager.

1. On the transmittal, record relevant information and requests for data. On the form, or separate sheet, record deviations from Contract Document requirements, including variations and limitations. Include Construction Manager's certification that information complies with Contract Document requirements.

1.6 SUBMITTAL SCHEDULE

A. After development and review by the Owner and Architect acceptance of the Construction Manager's CPM Schedule prepare a complete schedule of submittals. Submit the schedule to the Owner’s Representative within thirty (30) Calendar Days of Contract Award.

1. Coordinate Submittal Schedule with the list of subcontracts, Schedule of Values, and the list of products as well as the Construction Manager's CPM Schedule.

2. Prepare the schedule in chronological order. Provide the following information:

a. Schedule date for the initial submittal.

b. Related section number.

c. Submittal category (Shop Drawings, Product Data, or Samples).

d. Name of Subcontractor.

e. Description of the part of Work covered.

f. Scheduled date for resubmittal.

g. Scheduled date for the Architect's final release of approval.

B. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or modifications to submittals noted by the Architect and additional time for handling and reviewing submittals required by those corrections.

1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and CPM Schedule.
2. Initial Submittal: Submit concurrently with start-up construction schedule. Include submittals required during the first sixty (60) Calendar Days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
3. Final Submittal: Submit concurrently with the first complete submittal of Construction Manager's CPM Schedule.
   a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.

C. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Submit all submittal items required for each specification section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
3. Submit action submittals and informational submittals required by the same specification section as separate packages under separate transmittals.
4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
   a. Owner's Representative reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

D. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect and Owner's Representative receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Allow fifteen [15] [Insert number] days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect and Owner's Representative will advise Construction Manager when a submittal being processed must be delayed for coordination with related submittals not yet received. Additional time will be required if processing must be delayed to permit review of related subsequent submittals.
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.

3. Resubmittal Review: Allow fifteen [15] [Insert number] days for review of each resubmittal.
4. Mass Submittals: Six (6) or more submittals in one (1) day or 20 or more submittals in one (1) week. If "Mass Submittals" are received, Architect's review time stated above may be extended as necessary to perform proper review. Architect will review "Mass Submittals based upon priority determined by Architect after consultation with Owner and Construction Manager.

E. Distribution: Following response to the initial submittal, print and distribute copies to the Construction Administrator, Architect, Owner, subcontractors, and other parties required to comply with submittal dates indicated. Post copies in the Project meeting room and field office.

1. When revisions are made, distribute to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in construction activities.

F. Schedule Updating: Revise the schedule after each meeting or activity where revisions have been recognized or made. Issue the updated schedule concurrently with the report of each meeting.

1.7 DAILY CONSTRUCTION REPORTS

A. Prepare a daily construction report recording the following information concerning events at the site, and submit duplicate copies to the Construction Administrator at weekly intervals:

1. List of subcontractors at the site.
2. Approximate count of personnel at the site.
3. High and low temperatures, general weather conditions.
4. Accidents and unusual events.
5. Meetings and significant decisions.
6. Stoppages, delays, shortages, and losses.
7. Meter readings and similar recordings.
8. List of equipment on site and identify if idle or in use.
9. Orders and requests of governing authorities.
10. Change Orders received, start and end dates.
11. Services connected, disconnected.
12. Equipment or system tests and startups.
13. Partial Completion's, occupancies.
14. Substantial Completion's authorized.
15. Equals or Substitutions approved or rejected.

1.8 SHOP DRAWINGS

A. Submit newly prepared information drawn accurately to scale. Highlight, encircle, or otherwise indicate deviations from the Contract Documents. Do not reproduce Contract Documents or copy standard information as the basis of Shop Drawings. Standard information prepared without specific reference to the Project is not a Shop Drawing.

B. Shop Drawings include fabrication and installation Drawings, setting diagrams, schedules, patterns, templates and similar Drawings. Include the following information:

1. Dimensions.

2. Identification of products and materials included by sheet and detail number.

3. Compliance with specified standards.

4. Notation of coordination requirements.

5. Notation of dimensions established by field measurement.

6. Sheet Size: Except for templates, patterns and similar full-size Drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches but no larger than 36 by 48 inches.

7. Submit one (1) electronic copy as directed by the Construction Administrator. The Construction Manager's submittal shall identify the specification section and/or drawing number applicable to the submittal.

8. Details shall be large scale and/or full size.

C. The Construction Manager shall review the Shop Drawings, stamp with this approval, and submit them with reasonable promptness and in orderly sequence so as to cause no delay in his Work or in the Work of any subcontractor. Shop Drawings shall be properly identified as specified for item, material, workmanship, and project number. At the submission, the Construction Manager shall inform the Architect, in writing of any deviation in the shop drawings from the requirements of the Contract Documents.

D. The Architect will review and comment on shop drawings with reasonable promptness so as to cause no delay, but only for conformance with the design concept of the project and with the information given in the Contract Documents. Refer to Article 5 of the General Conditions. Shop Drawings received by the Architect that indicate insufficient study of drawings and specifications, illegible portions or gross errors, will be rejected outright. Such rejections shall not constitute an acceptable reason for granting the Construction Manager additional time to perform the work.

E. The Construction Manager shall make any corrections required by the Architect and shall resubmit the required number of corrected copies of Shop Drawings until fully reviewed.

F. Upon final review submit final electronic file in PDF format, same as submitted, for use by the Construction Administrator.

G. The Architect's review and comments on Shop Drawings shall not relieve the Construction Manager of responsibility for any deviation from the requirements of the Contract Documents.

H. Only final reviewed Shop Drawings are to be used on the Project site.

I. The Work installed shall be reviewed in accordance with the Shop Drawings and the drawings and specifications. Final Review of the Shop Drawings by the Architect shall constitute acceptance by the State and the Architect of a variation or departure that is clearly identified. If the Construction Manager believes notations made by the A/E increases the value or scope of the CD's, the Construction Manager must provide written notice to the Owner's Representative within seven (7) Calendar Days of this issue. Final reviewed Shop Drawings shall not replace or be used as a vehicle to issue or incorporate change orders or substitutions. Substitutions shall be submitted in accordance with Division 01 Section 01 25 00 "Substitution Procedures - CMR".

1.9 SHOP DRAWING FOR FIRE PROTECTION SYSTEMS

A. Shop drawings for fire protection systems shall comply with all of the requirements in the section above "Shop Drawings" In addition Sprinkler system shop drawings and hydraulic calculations must be stamped by a professional engineer licensed in the state of Connecticut and must include the CT DCS project number. Two (2) sets of information shall be submitted to the State's Insurance Carrier (SIC), and one (1) set shall be submitted to the Office of the State Fire Marshal (OSFM).

STATE INSURANCE CARRIER (SIC):
FM Global Boston Operations
Factory Mutual Insurance Company

Plan Review 500 River Ridge Drive
Norwood, MA 02062
Tel: (781) 440-8241 or FAX (781) 440-8742
Contact: BostonLeadEngineer@FMGlobal.com

CT DEPARTMENT OF CONSTRUCTION SERVICES
OFFICE OF STATE FIRE MARSHAL (OSFM)
1111 Country Club Road
Middletown, CT 06457
For addition information contact: Terry Brower (860) 685-8350

B. Before the shop drawings are submitted to SIC or Code (either SFM or DPW), the A/E and/or the A/E fire protection consultant must review the sprinkler design for compliance with the code and DPW requirements. SIC review comments will be addressed to the DPW Project Manager. The A/E is responsible for changes that result from the SIC and/or Code (SFM or DPW) required during construction.

1. The State Insurance Carrier (SIC) requires two- (2) weeks prior notice of a sprinkler system acceptance test.

1.10 PRODUCT DATA

A. Collect Product Data into a single submittal for each element of construction or system. Product Data includes printed information, schedules, such as manufacturer's installation instructions, catalog cuts, standard color charts, roughing-in diagrams and templates, standard wiring diagrams, and performance curves.

1. Mark each copy to show applicable choices and options. Where printed Product Data includes information on several products that are not required, mark copies to indicate the applicable information. Include the following information:

a. Manufacturer's printed recommendations.

b. Compliance with trade association standards.

c. Compliance with recognized testing agency standards.

d. Application of testing agency labels and seals.

e. Notation of dimensions verified by field measurement.

f. Notation of coordination requirements.

2. Do not submit Product Data until compliance with requirements of the Contract Documents has been confirmed.

3. Preliminary Submittal: Submit a preliminary single copy of Product Data where selection of options is required.

4. Submittals: Submit one electronic file of each required submittal; submit five (5) copies where required for maintenance manuals. The Architect will retain one (1) electronic file and will return the other marked with action taken and corrections or modifications required.

a. Unless noncompliance with Contract Document provisions is observed, the submittal may serve as the final submittal.

5. Distribution: Furnish copies of final submittal to installers, subcontractors, suppliers, manufacturers, fabricators, and others required for performance of construction activities. Show distribution on transmittal forms.

a. Do not proceed with installation until a copy of Product Data is in the Installer's possession.

b. Do not permit use of unmarked copies of Product Data in connection with construction.

1.11 SAMPLES

A. Submit full-size, fully fabricated Samples cured and finished as specified and physically identical with the material or product proposed. Samples include partial sections of manufactured or fabricated components, cuts or containers of materials, color range sets, and swatches showing color, texture, and pattern.

1. Coordinate with Architect which Samples are to be stored, mounted or displayed on site, in the manner to facilitate review of qualities indicated. Prepare Samples to match the Architect's sample. Include the following:

a. Specification Section number and reference.

b. Generic description of the Sample.

c. Sample source.

d. Product name or name of the manufacturer.

e. Compliance with recognized standards.

f. Availability and delivery time.

2. Submit Samples for review of size, kind, color, pattern, and texture. Submit Samples for a final check of these characteristics with other elements and a comparison of these characteristics between the final submittal and the actual component as delivered and installed.

a. Where variation in color, pattern, texture, or other characteristic is inherent in the material or product represented, submit at least three (3) multiple units that show approximate limits of the variations.

b. Refer to other Specification Sections for requirements for Samples that illustrate workmanship, fabrication techniques, details of assembly, connections, operation, and similar construction characteristics.

c. Refer to other Sections for Samples to be returned to the Construction Manager for incorporation in the Work. Such Samples must be undamaged at time of use. On the transmittal, indicate special requests regarding disposition of Sample submittals.

d. Samples not incorporated into the Work, or otherwise designated as the Owner's property, are the property of the Construction Manager and shall be removed from the site prior to Substantial Completion.

3. Preliminary Submittals: Submit a full set of choices where Samples are submitted for selection of color, pattern, texture, or similar characteristics from a range of standard choices, unless otherwise noted in specification section.

a. The Architect will review and return preliminary submittals with the Architects notation, indicating selection and other action.

4. Submittals: Except for Samples illustrating assembly details, workmanship, fabrication techniques, connections, operation, and similar characteristics, submit three (3) sets. The Architect will return one (1) set marked with the action taken.

5. Maintain sets of Samples, as returned, at the Project Site, for quality comparisons throughout the course of construction.

a. Unless noncompliance with Contract Document provisions is observed, the submittal may serve as the final submittal.

b. Sample sets may be used to obtain final acceptance of the construction associated with each set.

B. Distribution of Samples: Prepare and distribute additional sets to subcontractors, manufacturers, fabricators, suppliers, installers, and others as required for performance of the Work. Show distribution on transmittal forms.

1. Field samples are full-size examples erected on-site to illustrate finishes, coatings, or finish materials and to establish the Project standard.

   a. Comply with submittal requirements to the fullest extent possible. Process transmittal forms to provide a record of activity.

1.12 QUALITY ASSURANCE SUBMITTALS

A. Submit quality-control submittals, including design data, certifications, manufacturer's instructions, manufacturer's field reports, and other quality-control submittals as required under other Sections of the Specifications.

B. Certifications: Where other Sections of the Specifications require certification that a product, material, or installation complies with specified requirements, submit a notarized certification from the manufacturer certifying compliance with specified requirements.

1. Signature: Certification shall be signed by an officer of the manufacturer or other individual authorized to sign documents on behalf of the company.

C. Inspection and Test Reports: Requirements for submittal of inspection and test reports from independent testing agencies are specified in Division 01 Section 01 45 00 "Quality Control - CMR."

1.13 ARCHITECT'S ACTION

A. Except for submittals for the record or information, where action and return is required, the Architect will review each submittal, mark to indicate action taken, and return promptly.

1. Compliance with specified characteristics is the Construction Manager's responsibility.

B. Action Stamp: The Architect will stamp each submittal with a uniform, action stamp. The Architect will mark the stamp appropriately to indicate the action taken, as follows:

1. Final Unrestricted Release: When the Architect marks a submittal "Approved for fabrication," the Work covered by the submittal may proceed provided it complies with requirements of the Contract Documents. Final payment depends on that compliance.

2. Final-But-Restricted Release: When the Architect marks a submittal "Incorporate Notations," the Work covered by the submittal may proceed provided it complies with notations or corrections on the submittal and requirements of the Contract Documents. Submit corrected copies for record. Final payment depends on that compliance.

3. Returned for Resubmittal: When the Architect marks a submittal "Rejected, or Revise and Resubmit," do not proceed with Work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise or prepare a new submittal according to the notations; resubmit without delay. Repeat if necessary to obtain different action mark.

   a. Do not use, or allow others to use, submittals marked "Rejected, or Revise and Resubmit" at the Project Site or elsewhere where Work is in progress.

4. Other Action: Where a submittal is for information or record purposes or special processing or other activity, the Architect will return the submittal marked "Action Not Required."

C. Unsolicited Submittals: The Architect will discard unsolicited submittals without action.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01 33 00 - CMR

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Construction Documents and general provisions of the CMR Agreement Between Owner and Construction Manager and the Guaranteed Maximum Price (GMP) Amendment, including Division 00 General Conditions of the Contract for Construction – CMR and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for performing alteration and renovation Work as required at Jennings Hall.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 01 Section 01 31 00 "Project Management and Coordination - CMR" for procedures for coordinating cutting and patching with other construction activities.

2. Division 01 section 01 15 00 “Temporary Facilities” for protection required at Jennings Hall.

3. Division 01 Section 01 73 29 "Cutting and Patching - CMR" for procedures for cutting and patching.

4. Division 01 Section 01 74 19 "Construction Waste Management & Disposal - CMR" for the requirements for waste management goals, waste management plan and waste management plan implementation.

5. Division 02 Section 02 41 19 "Selective Structure Demolition" for demolition of selected portions of the building for alterations.

6. Division 02 Section 02 42 93 "Building Deconstruction" for deconstruction of selected portions of the building for alterations.

7. Refer to other Sections for specific requirements and limitations applicable to performing alteration Work with individual parts of the Work.

7. Requirements of this Section apply to mechanical and electrical installations. Refer to Division 21, 22, 23 and 26 Sections for other requirements and limitations applicable to renovation Work by mechanical and electrical installations.

PART 2 - PRODUCTS

2.1 PRODUCTS FOR PATCHING AND EXTENDING WORK

A. New materials: As specified in product sections; match existing Products and Work for patching and extending Work.

B. Type and Quality of Existing Products: Determine by inspecting and testing Products where necessary, referring to existing Work as a standard.

2.2 SALVAGEABLE MATERIALS

A. The Construction Manager shall be responsible for removing the following salvageable items from premises and transporting said items as directed by the Owner.

1. Equipment:
2. Windows:
3. Doors:
4. Door Hardware:

5. Fixtures:
6. Art:

B. The Construction Manager shall notify the Owner's Representative in writing seven (7) days prior to removing all salvageable items from the existing alteration project location and unloading all salvageable items and store items in the appropriate location as directed by the Owner's Representative.

PART 3 - EXECUTION

3.1 INSPECTION

A. General:

1. Verify that demolition is complete and areas are ready for installation of new Work.

2. Beginning of restoration Work means acceptance of existing conditions.

B. Project Procedures for Work Involving Lead Containing Material (LBP):

1. Exposure levels for lead in the construction industry are regulated by 29 CFR 1926.62. Construction activities disturbing surfaces containing lead-based paint (LBP) which are likely to be employed, such as sanding, grinding, welding, cutting and burning, have been known to expose workers to levels of lead in excess of the Permissible Exposure Limit (PEL). Conduct demolition and removal Work specified in the technical sections of this specification in conformance with these regulations. In addition, construction debris/waste may be classified as hazardous waste. Disposal of hazardous waste material shall be in accordance with 40 CFR Parts 260 through 271 and Connecticut Hazardous Waste Management Regulations Section 22a-209-1; 22a-209-8(c); 22a-449(c)-11; and 22a-449(c)-100 through 110.

2. The Construction Manager's Work shall be based on a child under the age of six (6) years in residence; the Work shall also be in accordance with Connecticut Regulations Section 19a-111-1 through 11.

3. This facility was constructed prior to 1978 and is likely to have painted surfaces containing lead-based paint.

4. In accordance with the United States Environmental Protection Agency's (EPA) Lead-Based Paint Renovation, Repair, and Painting Program (RRP) issued by the EPA on April 22, 2008 and regulated by 40 CFR 745, Contractors performing renovation, repair and painting project that disturb lead-based paint in homes, child care facilities, and schools built before 1078 must be certified and must follow specific work practices to prevent lead contamination. EPA requires that firms performing renovation, repair , and painting projects that disturb lead-based paint in pre-1978 homes, child care facilities and schools be certified by EPA and the they use certified renovators who are trained by EPA-approved training providers to follow lead-sage work practices. The Contractor must be a Renovation Firm that has completed an EPA Lead-Safe Certification Program a be certified to conduct lead-based paint activities and renovations under the RRP rule. The Contractor shall have at least one "Certified Renovator" assigned to jobs where LBP is disturbed.

5. Testing for lead-based paint has been conducted at the facility scheduled for renovation, demolition, reconstruction, alteration, remodeling, or repair. Results of the LBP testing are for information purposes only. The results are in Section 00 30 00 Available Information. Under no circumstance shall this information be the sole means used by the Contractor for determining the extent of LBP. The Contractor shall be responsible for verification of all field conditions affecting performance of the Work.

C. Project Procedures for Work Involving Asbestos Containing Material (ACM):

1. The Owner is responsible for abating all ACM that is visible and accessible. This is to be accomplished through a separate project prior to the start of the renovation project. In demolition projects, every attempt should be made by the Owner to remove all ACM.
2. If the Construction Manager should encounter any material suspect or known to contain ACM, the Construction Manager shall immediately notify the Owner's Representative of same. It is the Owner's responsibility to have the material tested and abated (if necessary). The Owner will respond within twenty-four (24) hours after receiving the Construction Manager's written request to the Owner's Representative for testing the suspect material. The Owner will abate ACM (if necessary) within a reasonable time period, i.e. within seven (7) days.
3. Testing for asbestos has been conducted at the facility scheduled for renovation, demolition, reconstruction, alteration, remodeling, or repair. Results of the asbestos testing are for information purposes only. The results are in Section 00 30 00 Available Information. Under no circumstance shall this information be the sole means used by the Construction Manager for determining the extent of asbestos. The Construction Manager shall be responsible for verification of all field conditions affecting performance of the Work.

D. Project Procedures for Work Involving Products Containing Persistent Bioaccumulative Toxic Chemicals" (PBT's) such as Polychlorinated Biphenols (PCB's), Di-2-ethylhexyl Phthalate (DEHP), and Mercury:

1. The Construction Manager is responsible for abating all PCB's, DEHP, and mercury prior to the start of any Work involving construction, renovation or demolition (if necessary).
2. Exposure Levels for Products Containing Persistent Bioaccumulative Toxic Chemicals (PBT's) such as PCB's. DEHP, and mercury in the construction industry is regulated by 29CFR1910.1200 and 29CFR1926.28 et. al. Construction, renovation or demolition activities disturbing Products Containing Persistent Bioaccumulative Toxic Chemicals" (PBT's) such as PCB's and DEHP which are likely to be employed. These materials include but are not limited to fluorescent light fixtures and exit signs, ballasts, high density discharge (HID) lamps, certain types of construction products containing vinyl, and mercury containing electrical switches and thermostats. These activities may expose workers in excess of the respective Permissible Exposure Limit (PEL). Conduct demolition and removal Work specified in the technical sections of these specifications in conformance with these regulations. In addition construction debris/waste may be classified as hazardous waste. Disposal of all hazardous materials shall be in accordance with but not limited to 40CRF Parts 761 Subpart K, 761, and 761.65 and the Connecticut General Hazardous Waste Statute Sec. 22a-454.
3. A Survey for Products Containing Persistent Bioaccumulative Toxic Chemicals (PBT's) such as PCB's, DEHP and Mercury has NOT been conducted at the facility. Examples include but are not limited to fluorescent light fixtures & exit signs, ballasts, high density discharge (HID) lamps, certain types of construction products containing vinyl, and mercury containing electrical switches and thermostats. It is the Construction Manager's responsibility to verify all materials and field conditions prior to construction, renovation, and demolition that may affect the performance of their Work.

E. See also Division 00 General Conditions of the Contract for Construction – CMR, Article 23 "Cutting, Fitting, Patching and Digging."

3.2 PREPARATION

A. Cut, move, or remove items as are necessary for access to alteration and renovation Work. Replace and restore at completion.

B. Remove unsuitable material not marked for salvage, such as rotted wood, corroded metals, and deteriorated masonry and concrete. Replace materials as specified for finished Work.

C. Remove debris and abandoned items from area and from concealed spaces.

D. Prepare surface and remove surface finishes to provide for proper installation of new Work and finishes.

E. Close openings in exterior surfaces to protect existing Work and salvageable items from weather and extremes of temperature and humidity. Insulate ductwork and piping to prevent condensation in exposed areas.

3.3 INSTALLATION

A. Coordinate alteration and renovation Work to expedite completion, and if required sequence Work to accommodate Owner occupancy.

B. Remove, cut and patch Work in a manner to minimize damage and to provide restoring products and finishes to original and or specified condition in accordance with Section 01 73 29 "Cutting and Patching - CMR."

C. Refinish visible existing surfaces to remain in renovated rooms and spaces, to specified condition for each material, with neat transition to adjacent finishes in accordance with Section 01 73 29 "Cutting and Patching - CMR."

D. In addition to specified replacement of equipment and fixtures, restore existing plumbing, heating, ventilation, air conditioning, and electrical systems to full operational condition.

E. Recover and refinish Work that exposes mechanical and electrical Work exposed accidentally during the Work.

F. Install products as specified in individual specification sections.

3.4 TRANSITIONS

A. Where new Work abuts or aligns with existing, perform a smooth and even transition. Patch work to match existing adjacent Work in texture and appearance.

B. When finished surfaces are cut so that a smooth transition with new Work is not possible, terminate existing surface along a straight line at a natural line of division and make recommendation to Architect/Engineer.

3.5 ADJUSTMENTS

A. Where removal of partitions or walls result in adjacent spaces becoming one, rework floors, walls, and ceilings to a smooth plane without breaks, steps, or bulkheads.

B. Where a change of plane of 1/4-inch in (12) inches or more occurs, request recommendation from Architect/Engineer for providing a smooth transition.

C. Trim existing doors as necessary to clear new floor finish. Refinish trim as required.

D. Fit Work at penetrations of surfaces as specified in Section 01 73 29 "Cutting and Patching - CMR."

3.6 REPAIR OF DAMAGED SURFACES

A. Patch or replace portions of existing surfaces that are damaged, lifted, discolored, or showing imperfections.

B. Repair substrate prior to patching finishes.

3.7 FINISHES

A. Finish surfaces as specified in individual product specification sections.

B. Finish patches to produce uniform finish and texture over entire area. When finish cannot be matched, refinish entire surface to nearest intersections.

3.8 CLEANING

A. In addition cleaning specified in Section 01 50 00 "Temporary Facilities and Controls - CMR"; clean Agency occupied areas of Work.

END OF SECTION 01 35 16 - CMR

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Construction Documents and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section

1.2 SUMMARY

A. This guide specification covers construction safety requirements and requirements for the protection of people, property, and resources. It is intended for use in construction, renovation, and demolition projects for the Department of Construction Services (DCS) State of CT.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 01 Section 01 33 00 Submittal Procedures – CMR" specifies the requirements for submittal requirements;
2. Division 01 Section 01 31 19 "Project Meetings - CMR" specifies requirements for submittal and distribution of meeting and conference minutes.

1.2 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE) www.asse.org/publications/	
ASSE/SAFE A10.32	(2004) Fall Protection
ASSE/SAFE A10.34	(2001; R 2005) Protection of the Public on or Adjacent to Construction Sites
ASSE/SAFE Z359.1	(2007) Safety Requirements for Personal Fall Arrest Systems, Subsystems and Components
AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME) www.asme.org/Codes/	
ASME B30.22	(2005) Articulating Boom Cranes
ASME B30.3	(2004) Construction Tower Cranes
ASME B30.5	(2004) Mobile and Locomotive Cranes
ASME B30.8	(2004) Floating Cranes and Floating Derricks
NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) www.nfpa.org/	
NFPA 10	(2002) Portable Fire Extinguishers
NFPA 51B	(2009) Standard for Fire Prevention During Welding, Cutting, and Other Hot Work
NFPA 241	(2000) Safeguarding Construction, Alteration, and Demolition Operations
NFPA 70	(2005) National Electrical Code
NFPA 70E	Standard for Electrical Safety in the Workplace
CODE OF FEDERAL REGULATIONS (CFR) www.archives.gov/federal-register/cfr/	
10 CFR	Standards for Protection Against Radiation
29 CFR 1910	Occupational Safety and Health Standards
29 CFR 1910.28	Safety Requirements For Scaffolding.
29 CFR 1910.146	Permit-required Confined Spaces

29 CFR 1910.147	Control Of Hazardous Energy (Lockout/Tagout)
29 CFR 1910.178	Powered industrial trucks.
29 CFR 1915	Confined and Enclosed Spaces and Other
29 CFR 1926	Safety and Health Regulations for Construction
29 CFR 1926.500	Fall Protection
29 CFR 1926.550	Cranes and Derricks
US Army Core of Engineers (USACE) www.iwr.usace.army.mil	
EM 385-1-1	Safety, and Health Requirements Manual (2008),

1.3 SUBMITTALS

A. An "O" followed by "A" indicates that the Owner acceptance; submittals not having an "O" designation are for Contractor Quality Control approval.

B. Submittal Procedures:

1. Preconstruction Submittals:
   a. Accident Prevention Plan (APP): “O, A”;
   b. Activity Hazard Analysis (AHA); “O, A”;
   c. Crane Critical Lift Plan; “O, A”;
   d. Proof of qualification for Crane Operators; O, A.
2. Test Reports: Submit reports as their incidence occurs, in accordance with the requirements of the paragraph entitled, "Reports."
   a. Accident Reports;
   b. Monthly Exposure Reports;
   c. Crane Reports;
   d. Regulatory Citations and Violations;
   e. Gas Protection.
3. Certificates:
   a. Confined Space Entry Permit;
   b. Hot work permit;
   c. License Certificates.
   d. Certificate of Compliance – Crane

1.4 DEFINITIONS

A. Competent Person. A competent person is one who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

B. Competent Person for Fall Protection. A person who is capable of identifying hazardous or dangerous conditions in the personal fall arrest system or any component thereof, as well as their application and use with related equipment, and has the authority to take prompt corrective measures to eliminate the hazards of falling.

C. Confined Space: A space which by design has limited openings for entry and exit, unfavorable natural ventilation which could contain or produce dangerous air contaminants, and which is not intended for continuous employee occupancy. Confined spaces include, but are not limited to storage tanks, process vessels, pits, silos, vats, degreasers, reaction vessels, boilers, ventilation and exhaust ducts, sewers, tunnels, underground utility vaults, and pipelines.

D. High Visibility Accident: Any mishap which may generate publicity and/or high visibility.

E. Medical Treatment; Medical treatment includes treatment administered by a physician or by registered professional personnel under the standing orders of a physician. Medical treatment does not include first aid treatment even through provided by a physician or registered personnel.

F. Operating Envelope: The area surrounding any crane. Inside this "envelope" is the crane, the operator, riggers and crane walkers, rigging gear between the hook and the load, the load and the crane's supporting structure (ground, rail, etc.).

G. Qualified Person for Fall Protection: A person with a recognized degree or professional certificate and with extensive knowledge, training and experience in the field of fall protection; who is capable of performing design, analysis, and evaluation of fall protection systems and equipment.

H. Recordable Injuries or Illnesses: Any work-related injury or illness that results in:
   1. Death, regardless of the time between the injury and death, or the length of the illness;
   2. Days away from work (any time lost after day of injury/illness onset);
   3. Restricted work;
   4. Transfer to another job;
   5. Medical treatment beyond first aid;
   6. Loss of consciousness; or
   7. A significant injury or illness diagnosed by a physician or other licensed health care professional, even if it did not result in (1) through (6) above.

I. Weight Handling Equipment (WHE) Accident: A WHE accident occurs when any one or more of the six elements in the operating envelope fails to perform correctly during operation, including operation during maintenance or testing resulting in personnel injury or death; material or equipment damage; dropped load; derailment; two-blocking; overload; and/or collision, including unplanned contact between the load, crane, and/or other objects. A dropped load, derailment, two-blocking, overload and collision are considered an accident even though no material damage or injury occurs. A component failure (e.g., motor burnout, gear tooth failure, bearing failure) is not considered an accident solely due to material or equipment damage unless the component failure results in damage to other components (e.g., dropped boom, dropped load, roll over, etc.).

1.5 REGULATORY REQUIREMENTS

A. In addition to the detailed requirements included in the provisions of this Section see, Division 01, Section 01 42 20 "Reference Standards and Definitions" for other state laws, criteria, rules and regulations. Submit matters of interpretation of standards to the appropriate administrative agency for resolution before starting work. Where the requirements of this specification, applicable laws, criteria, regulations, and referenced documents vary, the most stringent requirements govern.

1.6 SITE QUALIFICATIONS, DUTIES, AND MEETINGS

A. Personnel Qualifications:

B. Site Safety and Health Officer (SSHO):
   1. Provide a Site Safety and Health Officer (SSHO) at the work site at all times to perform safety and occupational health management, surveillance, inspections, and safety enforcement for the Contractor. The Contractor Quality Control (QC) person [cannot be the SSHO on this project, even though the QC has safety inspection responsibilities as part of the QC duties.] [can be the SSHO on this project.] Meet the following requirements within the SSHO:

[Level 1: Worked on similar projects. 10-hour OSHA construction safety class or equivalent within last three (3) years. Competent person training as needed.]

[Level 2: A minimum of three (3) years safety work on similar project. 30-hour OSHA construction safety class or equivalent within last 3 years. Competent person training as needed.]

OR

[Level 3: A minimum of five (5) years safety work on similar projects. 30-hour OSHA construction safety class or equivalent within the last 5 years. An average of at least 24 hours of formal safety training each year for the past 5 years. Competent person training as needed.]

[Level 4: A minimum of ten (10) years safety work of a progressive nature with at least 5 years of experience on similar projects. 30-hour OSHA construction safety class or equivalent within the last 5 years. An average of at least 24 hours of formal safety training each year for the past 5 years with training for competent person status for at least the following [four] [4] areas of competency: [Excavation]; [Scaffolding]; [Fall protection]; [Hazardous energy]; [Confined space]; [Health hazard recognition, evaluation and control of chemical, physical and biological agents]; [Personal protective equipment and clothing to include selection, use and maintenance]; [_____].]

[Level 5: An Associate Safety Professional (ASP), Certified Safety Trained Supervisor (STS) and/or Construction Health & Safety Technician (CHST). A minimum of 10 years safety work of a progressive nature with at least five (5) years of experience on similar projects. 30-hour OSHA construction safety class or equivalent within the last five (5) years. An average of at least 24 hours of formal safety training each year for the past 5 years with training for competent person status for at least the following [four] [4] areas of competency: [Excavation]; [Scaffolding]; [Fall protection]; [Hazardous energy]; [Confined space]; [Health hazard recognition, evaluation and control of chemical, physical and biological agents]; [Personal protective equipment and clothing to include selection, use and maintenance]; [Insert].]

[Level 6: A Certified Safety Professional (CSP) and/or Certified Industrial Hygienist (CIH). A minimum of ten (10) years safety work of a progressive nature with at least five (5) years of experience on similar projects. 30-hour OSHA construction safety class or equivalent within the last five (5) years. An average of at least 24 hours of formal safety training each year for the past five (5) years with training for competent person status for at least the following [four] [4] areas of competency: [Excavation]; [Scaffolding]; [Fall protection]; [Hazardous energy]; [Confined space]; [Health hazard recognition, evaluation and control of chemical, physical and biological agents]; [Personal protective equipment and clothing to include selection, use and maintenance]; [Insert].]

[C. Certified Safety Professional (CSP) and/or Certified Industrial hygienist (CIH):
Provide a [Certified Safety Professional (CSP)] [and][or] [Certified Industrial Hygienist (CIH)] at the work site to perform safety and occupational health management, surveillance, inspections, and safety enforcement for the Contractor. The [CSP] [and][or] [CIH] shall be the safety and occupational health "competent person" as defined by this section. [The [CSP and/or CIH] shall have no other duties than safety and occupational health management, inspections, and/or industrial hygiene.]

[D. Associate Safety professional (ASP), Certified Safety Trained Supervisor (STS) and/or Construction Health and Safety Technician (CHST):

Provide [a/an] [Associate Safety Professional (ASP)][Certified Safety Trained Supervisor (STS)] [and/or] [Construction Health & Safety Technician (CHST)] at the work site to perform safety management, surveillance, inspections, and safety enforcement for the Contractor. The [ASP][STS] [and/or] [CHST] shall be the safety and occupational health "competent person" as defined by this section. The [ASP][STS] [and/or] [CHST] shall be at the work site at all times whenever work or testing is being performed and shall conduct and document daily safety inspections. The [ASP][STS] [and/or] [CHST] shall have no other duties other than safety and occupational health management, inspections, and enforcement on this contract.

E. Crane Operators:
Meet the crane Operators and Crane operation requirements of the Connecticut Bureau of License and Permits – Cranes, Department of Construction Services, Office of State Fire Marshal pursuant to C.G.C § 29-221 through 29-230. Provide proof of current license and qualification. For more information visit the DPS Website http www.ct.gov/dcs and click on “Office of State Fire Marshall” or call (860) 685-8470

F. Personnel Duties:
1. Site Safety and Health Officer (SSHO):
   a. Conduct daily safety and health inspections and maintain a written log which includes area/operation inspected, date of inspection, identified hazards, recommended corrective actions, estimated and actual dates of corrections. Attach safety inspection logs to the Contractors' daily [production][quality control] report.
   b. Conduct mishap investigations and complete required reports. Maintain the OSHA Form 300 and Daily Production reports for prime and sub-contractors. For more information visit the OSHA website at www.osha.gov.
   c. Maintain applicable safety reference material on the job site.
   d. Attend the pre-construction conference, pre-work meetings including preparatory inspection meeting, and periodic in-progress meetings.
   e. Implement and enforce accepted APPS and AHAs.
   f. Maintain a safety and health deficiency tracking system that monitors outstanding deficiencies until resolution. Post a list of unresolved safety and health deficiencies on the safety bulletin board.
   g. Ensure sub-contractor compliance with safety and health requirements.

   Failure to perform the above duties will result in dismissal of the superintendent and/or SSHO, and a project work stoppage. The project work stoppage will remain in effect pending approval of a suitable replacement.

[2. [Certified Safety Professional (CSP)][Certified Industrial Hygienist (CIH)][Associate Safety Professional (ASP)][Certified Safety Trained Supervisor (STS)][and/or][Certified Construction Health & Safety Technician (CHST)]:
   a. Perform safety and occupational health management, surveillance, inspections, and safety enforcement for the project.
   b. Perform as the safety and occupational health "competent person" as defined by this section.
   c. Be on-site at least weekly whenever work or testing is being performed.
   d. Conduct and document safety inspections.
   e. Shall have no other duties other than safety and occupational health management, inspections, and enforcement on this contract.

   If the [CSP][CIH][ASP][STS][CHST] is appointed as the SSHO all duties of that position shall also be performed.

G. Meetings:

1. Preconstruction Conference:
   a. Contractor representatives who have a responsibility or significant role in accident prevention on the project shall attend the preconstruction conference. This includes the project superintendent, site safety and health officer, quality control supervisor, or any other assigned safety and health professionals who participated in the development of the Accident Prevention Plan (APP); (including the Activity Hazard Analyses (AHAs), and special plans, program and procedures associated with it).
   b. Discuss the details of the submitted APP to include incorporated plans, programs, procedures and a listing of anticipated AHAs that will be developed and implemented during the performance of the contract. This list of proposed AHAs will be reviewed at the conference and an agreement will be reached between the Contractor and the Owner's representative as to which phases will require an analysis. In addition, establish a schedule for the preparation, submittal, review, and acceptance of AHAs to preclude project delays.
   c. Deficiencies in the submitted APP will be brought to the attention of the Contractor at the preconstruction conference, and the Contractor shall revise the plan to correct deficiencies and re-submit it for acceptance. Do not begin work until there is an accepted APP.
2. Safety Meetings:
   Safety meetings shall be conducted to review past activities, plan for new or changed operations, review pertinent aspects of appropriate AHA (by trade), establish safe working procedures for anticipated hazards, and provide pertinent safety and health training and motivation.
   a. Meetings shall be conducted at least once a month for all supervisors on the project location and at least once a week for all workers by supervisors or foremen.
   b. Meetings shall be documented, including the date, persons in attendance, subjects discussed, and names of individual(s) who conducted the meeting. Documentation shall be maintained and copies furnished to the CA on request.
   c. The CA shall be informed of all scheduled meetings in advance and be invited to attend.

1.7 ACCIDENT PREVENTION PLAN (APP):

A. Use a qualified person to prepare the written site-specific APP.

1. Prepare the APP in accordance with the format and requirements of US Army Core of Engineers (USACE), Safety, and Health Requirements Manual, EM 385-1-1, or as approved by the CA and as supplemented herein. Cover all paragraphs and subparagraph elements in USACE EM 385-1-1, Appendix A, "Minimum Basic Outline for Accident Prevention Plan" or as approved by the CA. The USACE Safety, and Health Requirements Manual, EM 385-1-1 is available at the USACE Website www.iwr.usace.army.mil.
2. Specific requirements for some of the APP elements are described in "B" below. The APP shall be job-specific and address any unusual or unique aspects of the project or activity for which it is written.

B. The APP shall interface with the Contractor's overall safety and health program. Include any portions of the Contractor's overall safety and health program referenced in the APP in the applicable APP element and made site-specific. The Owner considers the Prime General Contractor to be the "controlling authority" for all work site safety and health of the subcontractors. Contractors are responsible for informing their subcontractors of the safety provisions under the terms of the contract and the penalties for noncompliance, coordinating the work to prevent one craft from interfering with or creating hazardous working conditions for other crafts, and inspecting subcontractor operations to ensure that

accident prevention responsibilities are being carried out. The APP shall be signed by the person and firm (senior person) preparing the APP, the Contractor, the on-site superintendent, the designated site safety and health officer and any designated Certified Safety Professional (CSP) and/or Certified Industrial Hygienist (CIH).

C. Submit the APP to the CTDCS Project Manager and Construction Administrator fourteen (14) calendar days prior to the date of the preconstruction conference for acceptance. Work cannot proceed without an accepted APP. Once accepted by the CTDCS Project Manager and Construction Administrator, the APP and attachments will be enforced as part of the contract. Disregarding the provisions of this contract or the accepted APP will be cause for stopping of work, at the discretion of the CTDCS Project Manager and Construction Administrator, until the matter has been rectified. Once work begins, changes to the accepted APP shall be made with the knowledge and concurrence of the CTDCS Project Manager and Construction Administrator, project superintendent, Site Safety and Health Officer (SSHO) and quality control manager. Should any hazard become evident, stop work in the area, secure the area, and develop a plan to remove the hazard. Notify the CTDCS Project Manager and Construction Administrator within twenty (24) hours of discovery. Eliminate/remove the hazard. In the interim, take all necessary action to restore and maintain safe working conditions in order to safeguard onsite personnel, visitors, the public (as defined by American Society of Safety Engineers, ASSE/SAFE A10.34 - Protection of the Public on or Adjacent to Construction Sites, see www.asse.org) and the environment.

Copies of the accepted plan will be maintained at the CA's office at the job site. Continuously reviewed and amended the APP, as necessary, throughout the life of the contract. Incorporate unusual or high-hazard activities not identified in the original APP as they are discovered.

D. APP Contents:
The contents of the Accident Prevention Plan (APP) shall be in accordance with Appendix A of the US Army Corps of Engineers, EM 385-1-1 Safety and Health Requirements Manual, Appendix A, Minimum Basic Outline for Accident Prevention Plans or as approved by the CA. For more information visit the USACE Website at www.usace.army.mil/Library.

1.8 ACTIVITY HAZARD ANALYSIS (AHA): Activity Hazard Analyses (AHAs) define the activities being performed and identify the sequences of work, the specific hazards anticipated, site conditions, equipment, materials, and the control measures to be implemented to eliminate or reduce each hazard to an acceptable level of risk. The Activity Hazard Analysis (AHA) format shall be in accordance with US Army Corps of Engineers, EM 385-1-1 Safety and Health Requirements Manual or as approved by the CA.

A. Submittals:

1. Submit initial AHA to CA for review at least [fifteen] [15] [Insert] calendar days prior to the start of each phase. Format subsequent AHAs as amendments to the APP. The analysis should be used during daily inspections to ensure the implementation and effectiveness of the activity's safety and health controls.

2. The AHA list will be reviewed monthly at the Contractor supervisory safety meeting and updated as necessary when procedures, scheduling, or hazards change. Develop the activity hazard analyses using the project schedule as the basis for the activities performed. Any activities listed on the project schedule will require an AHA. The AHAs will be developed by the contractor, supplier or subcontractor and provided to the prime contractor for submittal to the CA.

1.9 DISPLAY OF SAFETY INFORMATION

Within [one] [1] [Insert] calendar day(s) after commencement of work, erect a safety bulletin board at the job site. Include and maintain information on safety bulletin board as required by US Army Corps of Engineers, EM 385-1-1 Safety and Health Requirements Manual, Section 01.A.06 or as approved by the CA. Additional items required to be posted include:

A. Confined space entry permit.

B. Hot work permit.

1.10 SITE SAFETY REFERENCE MATERIALS

Maintain safety-related references applicable to the project, including those listed in the article "References." Maintain applicable equipment manufacturer's manuals.

1.11 EMERGENCY MEDICAL TREATMENT

Contractors will arrange for their own emergency medical treatment. The Owner has no responsibility to provide emergency medical treatment.

1.12 REPORTS

A. Accident Reports

1. Conduct an accident investigation for recordable injuries and illnesses, and property damage accidents resulting in at least $2,000 in damages, to establish the root cause(s) of the accident, complete “Accident Report Form” approved by the CA. Provide the report to the CA within [five] [5] [Insert] calendar days of the accident.

B. Accident Notification

Notify the CA as soon as practical, but not later than [four hours] [4] [Insert], after any accident meeting the definition of Recordable Injuries or Illnesses or High Visibility Accidents, property damage equal to or greater than $2,000, or any weight handling equipment accident.

1. Within notification include the following:

a. contractor name;
b. contract title;
c. type of contract;
d. name of activity,
e. installation or location where accident occurred;
f. date and time of accident;
g. names of personnel injured;
h. extent of property damage, if any; extent of injury, if known, and brief description of accident [to include type of construction equipment used, Personal Protective Equipment (PPE) used, etc.]. Preserve the conditions and evidence on the accident site until the U.S. Department of Labor, Occupational Safety and Health Administration (USDOL-OSHA) investigation team arrives on-site and USDOL-OSHA investigation is conducted.

C. Monthly Exposure Reports

Monthly exposure reporting to the CA is required to be attached to the monthly Application for Payment request. This report is a compilation of employee-hours worked each month for all site workers, both prime and subcontractor. Provide on a form approved by the CA.

D. Crane Reports

Submit crane inspection reports on a form approved by the CA and as specified herein with Daily Reports of Inspections.

E. HOT WORK

Hot Work shall only be performed in accordance with the requirements of NFPA 51B "Fire Prevention During Welding, Cutting and Other Hot Work Standard.

1. Definitions:
   a. Hot Work: Work involving burning, welding, or a similar operation that is capable of initiating fires or explosions. Examples listed by NFPA include arc welding, oxygen- fuel gas welding, open-flame soldering, brazing, thermal spraying, oxygen cutting, and arc cutting.

   b. Permit Authorizing Individual (PAI). Means the individual designated by the General Contractor to authorize hot work. The PAI is permitted to be, among others, the General Contractor's project executive, supervisor, foreperson, or designated safety administrator. The PAI CANNOT be the hot work operator, except as permitted in NFPA 51B. The PAI is aware of the fire hazards involved and is familiar with the provisions of this standard.

2. Permit: Submit and obtain a written permit from the PAI prior to performing "Hot Work" (welding, cutting, etc.) or operating other flame-producing/spark producing devices, from the PAI. CONTRACTORS ARE REQUIRED TO MEET ALL CRITERIA BEFORE A PERMIT IS ISSUED. The General Contractor will provide at least two (2) twenty (20) pound 4A:20 BC rated extinguishers for normal "Hot Work". All extinguishers shall be current inspection tagged, approved safety pin and tamper resistant seal.

3. Fire Watch: It is also mandatory to have a designated FIRE WATCH for any "Hot Work" done at this activity. The Fire Watch shall be trained in accordance with NFPA 51B Standard for Fire Prevention During Welding, Cutting, and Other Hot Work and remain on-site for a minimum of thirty (30) minutes after completion of the task or as specified on the hot work permit. When starting work in the facility, require personnel to familiarize themselves with the location of the nearest fire alarm boxes and place in memory the local fire department emergency phone number(s). ANY FIRE, NO MATTER HOW SMALL, SHAL BE REPORTED TO THE LOCAL FIRE DEPARTMENT, GENERAL CONTRACTOR'S AUTHORIZED REPRESENTATIVE, AND OWNER'S CA IMMEDIATELY.

1.13 FACILITY OCCUPANCY CLOSURE

Streets, walks, and other facilities occupied and used by the state User Agency shall not be closed or obstructed without written permission from the CA.

1.18 SEVERE STORM PLAN

In the event of a severe storm warning, the Contractor must:

A. Secure outside equipment and materials and place materials that could be damaged in protected areas.

B. Check surrounding area, including roof, for loose material, equipment, debris, and other objects that could be blown away or against existing facilities.

C. Ensure that temporary erosion controls are adequate.

PART 2 PRODUCTS

NOT USED.

PART 3 EXECUTION

3.1 CONSTRUCTION AND/OR OTHER WORK

Comply with the Connecticut State Building and Fire Safety Codes, OSHA regulations, and other references regulations. The most stringent standard prevails.

3.1.2 HAZARDOUS MATERIAL EXCLUSIONS

Notwithstanding any other hazardous material used in this contract, radioactive materials or instruments capable of producing ionizing/non-ionizing radiation (with the exception of radioactive material and devices used in accordance with USACE EM 385-1-1 such as nuclear density meters for compaction testing and laboratory equipment with radioactive sources) as well as materials which contain asbestos, mercury or polychlorinated biphenyls, di-isocynates, lead-based paint are prohibited. The CA, upon written request by the Contractor, may consider exceptions to the use of any of the above excluded materials.

3.1.3 UNFORESEEN HAZARDOUS MATERIAL

A. Related Section: Division 01, Section 01 35 16, Alteration Project Procedures.

3.2 PRE-OUTAGE COORDINATION MEETING

Contractors are required to apply for utility outages at least fifteen (15) days in advance. As a minimum, the request should include the location of the outage, utilities being affected, duration of outage and any necessary sketches. Special requirements for electrical outage requests are contained elsewhere in this specification section. Once approved, and prior to beginning work on the utility system requiring shut down, attend a pre-outage coordination meeting with the CA, User Agency Representative, and Public Utilities representative to review the scope of work and the lock-out/tag-out procedures for worker protection. No work will be performed on energized electrical circuits unless proof is provided that no other means exist.

3.3 SAFETY LOCKOUT/TAGOUT PROCEDURES

A. The General Contractor shall ensure that each employee is familiar with and complies with these procedures and OSHA 29 CFR 1910.147 Control Of Hazardous Energy (Lockout/Tagout).

1. The General Contractor's “Authorized Employee” shall apply lockout/tagout tags and take other actions that, because of experience and knowledge, are known to be necessary to make the particular equipment safe to work on.
2. No person, regardless of position or authority, shall operate any switch, valve, or equipment that has an official lockout/tagout tag attached to it, nor shall such tag be removed except as provided in this section.
3. No person shall work on any equipment that requires a lockout/tagout tag unless he, his immediate supervisor, project leader, or a subordinate has in his possession the stubs of the required lockout/tagout tags. Only qualified personnel shall perform work on electrical circuits.
4. A supervisor who is required to enter an area protected by a lockout/tagout tag will be considered a member of the protected group provided he notifies the holder of the tag stub each time he enters and departs from the protected area.
5. Identification markings on building light and power distribution circuits shall not be relied on for established safe work conditions.
6. Before clearance will be given on any equipment other than electrical (generally referred to as mechanical apparatus), the apparatus, valves, or systems shall be secured in a passive condition with the appropriate vents, pins, and locks. Pressurized or vacuum systems shall be vented to relieve differential pressure completely. Vent valves shall be tagged open during the course of the work. Where dangerous gas or fluid systems are involved, or in areas where the environment may be oxygen deficient, system or areas shall be purged, ventilated, or otherwise made safe prior to entry.

B. Tag Placement

Lockout/tagout tags shall be completed in accordance with the regulations printed on the back thereof and attached to any device which, if operated, could cause an unsafe condition to exist. If more than one group is to work on any circuit or equipment, the employee in charge of each group shall have a separate set of lockout/tagout tags completed and properly attached. When it is required that certain equipment be tagged, the State of Connecticut Authority Having Jurisdiction will review the characteristics of the various systems involved that affect the safety of the operations and the work to be done; take the necessary actions, including voltage and pressure checks, grounding, and venting, to make the system and equipment safe to work on; and apply such lockout/tagout tags to those switches, valves, vents, or other mechanical devices needed to preserve the safety provided. This operation is referred to as "Providing Safety Clearance."

C. Tag Removal
When any individual or group has completed its part of the work and is clear of the circuits or equipment, the supervisor, project leader, or individual for whom the equipment was tagged shall turn in his signed lockout/tagout tag stub to the Contractor. That group's or individual's lockout/tagout tags on equipment may then be removed on authorization by the Contractor.

3.4 FALL HAZARD PROTECTION AND PREVENTION PROGRAM
Establish a fall protection and prevention program, for the protection of all employees exposed to fall hazards. Within the program include company policy, identify responsibilities, education and training requirements, fall hazard identification, prevention and control measures, inspection, storage, care and maintenance of fall protection equipment and rescue and evacuation procedures.

A. Training
Institute a fall protection training program. As part of the Fall Hazard Protection and Prevention Program, provide training for each employee who might be exposed to fall hazards. Provide training by a competent person for fall protection in accordance with USACE EM 385-1-1, Section 21.A.16.

B. Fall Protection Equipment and Systems
Enforce use of the fall protection equipment and systems designated for each specific work activity in the Fall Protection and Prevention Plan and/or AHA at all times when an employee is exposed to a fall hazard. Protect employees from fall hazards as specified in USACE EM 385-1-1, section 21. In addition to the required fall protection systems, safety skiff, personal floatation devices, life rings etc., are required when working above or next to water in accordance with USACE EM 385-1-1, paragraphs 05.H. and 05.I. Personal fall arrest systems are required when working from an articulating or extendible boom, swing stages, or suspended platform. In addition, personal fall arrest systems are required when operating other equipment such as scissor lifts if the work platform is capable of being positioned outside the wheelbase. The need for tying-off in such equipment is to prevent ejection of the employee from the equipment during raising, lowering, or travel. Fall protection must comply with OSHA 29 CFR 1926.500, Fall Protection, Subpart M, and ASSE/SAFE A10.32, Fall Protection.

1. Personal Fall Arrest Equipment
Personal fall arrest equipment, systems, subsystems, and components shall meet ASSE/SAFE Z359.1, Safety Requirements for Personal Fall Arrest Systems, Subsystems and Components. Only a full-body harness with a shock-absorbing lanyard or self-retracting lanyard is an acceptable personal fall arrest body support device. Body belts may only be used as a positioning device system (for uses such as steel reinforcing assembly and in addition to an approved fall arrest system). Harnesses shall have a fall arrest attachment affixed to the body support (usually a

Dorsal D-ring) and specifically designated for attachment to the rest of the system. Only locking snap hooks and carabiners shall be used. Webbing, straps, and ropes shall be made of synthetic fiber. The maximum free fall distance when using fall arrest equipment shall not exceed 1.8 m (6 feet). The total fall distance and any swinging of the worker (pendulum-like motion) that can occur during a fall shall always be taken

2. Fall Protection for Roofing Work
Implement fall protection controls based on the type of roof being constructed and work being performed. Evaluate the roof area to be accessed for its structural integrity including weight-bearing capabilities for the projected loading.
   a. Low Sloped Roofs:
      (i) For work within 6 feet (1.8 m) of an edge, on low-slope roofs, Protect personnel from falling by use of personal fall arrest systems, guardrails, or safety nets.
      (ii) For work greater than 6 feet (1.8 m) from an edge, erect and install warning lines in accordance with OSHA 29 CFR 1926.500, Fall Protection.
   b. Steep-Sloped Roofs: Work on steep-sloped roofs requires a personal fall arrest system, guardrails with toe-boards, or safety nets. This requirement also includes residential or housing type construction.

3. Existing Anchorage
Certified (or re-certified) by a qualified person for fall protection existing anchorages, to be used for attachment of personal fall arrest equipment in accordance with ASSE/SAFE Z359.1, Safety Requirements for Personal Fall Arrest Systems, Subsystems and Components. Exiting horizontal lifeline anchorages must be certified (or re-certified) by a registered professional engineer with experience in designing horizontal lifeline systems.

4. Horizontal Lifelines
Design, install, certify and use under the supervision of a qualified person horizontal lifelines for fall protection as part of a complete fall arrest system which maintains a safety factor of 2 (OSHA 29 CFR 1926.500 Fall Protection).

5. Guardrails and Safety Nets
Design, install and use guardrails and safety nets in accordance with 29 CFR 1926, Safety and Health Regulations for Construction Subpart M.

6. Rescue and Evacuation Procedures
When personal fall arrest systems are used, the contractor must ensure that the mishap victim can self-rescue or can be rescued promptly should a fall occur. Prepare a Rescue and Evacuation Plan and include a detailed discussion of the following: methods of rescue; methods of self-rescue; equipment used; training requirement; specialized training for the rescuers; procedures for requesting rescue and medical assistance; and transportation routes to a medical facility. Include the Rescue and Evacuation Plan within the Activity Hazard Analysis (AHA) for the phase of work, in the Fall Protection and Prevention (FP&P) Plan, and the Accident Prevention Plan (APP).

3.5 SCAFFOLDING

A. The Contractor shall provide all employees with a safe means of access to the work area on the scaffold in accordance with OSHA 29 CFR 1910.28 Safety Requirements For Scaffolding and as contained in this section.
   1. Climbing of any scaffold braces or supports not specifically designed for access is prohibited.

2. Access scaffold platforms greater than 20 feet (6 m) maximum in height by use of a scaffold stair system.

3. Do not use vertical ladders commonly provided by scaffold system manufacturers for accessing scaffold platforms greater than 20 feet (6 m) maximum in height.

4. The use of an adequate gate is required.

5. Ensure that employees are qualified to perform scaffold erection and dismantling.

6. Do not use scaffold without the capability of supporting at least four times the maximum intended load or without appropriate fall protection as delineated in the accepted fall protection and prevention plan.

7. Stationary scaffolds must be attached to structural building components to safeguard against tipping forward or backward.

8. Give special care to ensure scaffold systems are not overloaded. Side brackets used to extend scaffold platforms on self-supported scaffold systems for the storage of material are prohibited.

9. The first tie-in shall be at the height equal to 4 times the width of the smallest dimension of the scaffold base. Place work platforms on mud sills. Scaffold or work platform erectors shall have fall protection during the erection and dismantling of scaffolding or work platforms that are more than six feet. Delineate fall protection requirements when working above six feet or above dangerous operations in the Fall Protection and Prevention (FP&P) Plan and Activity Hazard Analysis (AHA) for the phase of work.

B. Stilts
The use of stilts for gaining additional height in construction, renovation, repair or maintenance work is PROHIBITED.

3.6 EQUIPMENT

A. Material Handling Equipment
Material Handling Equipment shall be in accordance with OSHA 29 CFR 1910.178 Powered Industrial Trucks and as contained in this section.

1. Material handling equipment such as forklifts shall not be modified with work platform attachments for supporting employees unless specifically delineated in the manufacturer's printed operating instructions.

2. The use of hooks on equipment for lifting of material must be in accordance with manufacturer's printed instructions.

3. Operators of forklifts or power industrial trucks shall be licensed in accordance with OSHA.

B. Weight Handling Equipment

1. Equip cranes and derricks as specified in ASME B30.5 or ASME B30.22 or ASME B30.8 as applicable.

2. Comply with the crane manufacturer's specifications and limitations for erection and operation of cranes and hoists used in support of the work. Perform erection under the supervision of a designated person (as defined in ASME B30.5).

Perform all testing in accordance with the manufacturer's recommended procedures.

3. Comply with ASME B30.5 for mobile and locomotive cranes, ASME B30.22 for articulating boom cranes, ASME B30.3 for construction tower cranes, and ASME B30.8 for floating cranes and floating derricks.

4. Under no circumstance shall a Contractor make a lift at or above

5. When operating in the vicinity of overhead transmission lines, operators and riggers shall be alert to this special hazard and follow the requirements of ASME B30.5 or ASME B30.22 as applicable.

6. Do not crane suspended personnel work platforms (baskets) unless the Contractor proves that using any other access to the work location would provide a greater hazard to the workers or is impossible. Do not lift personnel with a line hoist or friction crane.

7. Inspect, maintain, and recharge portable fire extinguishers as specified in NFPA 10, Standard for Portable Fire Extinguishers.

8. All employees must keep clear of loads about to be lifted and of suspended loads.

9. Use cribbing when performing lifts on outriggers.

10. The crane hook/block must be positioned directly over the load. Side loading of the crane is prohibited.

11. A physical barricade must be positioned to prevent personnel from entering the counterweight swing (tail swing) area of the crane.

12. Certification records which include the date of inspection, signature of the person performing the inspection, and the serial number or other identifier of the crane that was inspected shall always be available for review by CA.

13. Written reports listing the load test procedures used along with any repairs or alterations performed on the crane shall be available for review by CA.

14. Certify that all crane operators have been trained in proper use of all safety devices (e.g. anti-two block devices).

C. USE OF EXPLOSIVES

Explosives shall not be used or brought to the project site without prior written approval from the CA. Such approval shall not relieve the Contractor of responsibility for injury to persons or for damage to property due to blasting operations. Storage of explosives, when permitted on State property, shall be only where directed and in approved storage facilities. These facilities shall be kept locked at all times except for inspection, delivery, and withdrawal of explosives. Explosive work shall be performed in accordance with the requirements of C.G.S. § 29-343 through 29-355 and as required by the Office of State Fire Marshal, CT Department of Construction Services.

3.7 EXCAVATIONS

A. Perform soil classification by a competent person in accordance with 29 CFR 1926 Safety and Health Regulations for Construction.

1. Utility Locations
   All underground utilities in the work area must be positively identified by and coordinated in accordance with Division 00, General Conditions-CMR, Article 18 Surveys, Permits, And Regulations. All underground utilities in the work area must be positively identified by a private utility locating service and coordinated with the public utility company. Any markings made during the utility investigation must be maintained by the general Contractor throughout the contract.
2. Utility Location Verification
   The Contractor must physically verify underground utility locations by hand digging using wood or fiberglass handled tools when any adjacent construction work is expected to come within three feet of the underground system. Digging within two (2) feet (610 mm) of a known utility must not be performed by means of mechanical equipment; hand digging shall be used. If construction is parallel to an existing utility expose the utility by hand digging every one hundred (100) feet (30.5 m) if parallel within 5 feet (1.5 m) of the excavation.
3. Shoring Systems
   Trench and shoring systems must be identified in the accepted safety plan and AHA. Manufacture tabulated data and specifications or registered engineer tabulated data for shoring or benching systems shall be readily available on-site for review. Job-made shoring or shielding must have the registered professional engineer stamp, specifications, and tabulated data. Extreme care must be used when excavating near direct burial electric underground cables.
4. Trenching Machinery
   Operate trenching machines with digging chain drives only when the spotters/laborers are in plain view of the operator. Provide operator and spotters/laborers training on the hazards of the digging chain drives with emphasis on the distance that needs to be maintained when the digging chain is operating. Keep documentation of the training on file at the project site.

3.8 UTILITIES WITHIN CONCRETE SLABS

A. Utilities located within concrete slabs or pier structures, bridges, and the like, are extremely difficult to identify due to the reinforcing steel used in the construction of these structures. Whenever contract work involves concrete chipping, saw cutting, or core drilling, the existing utility location must be coordinated with utility company in addition to a private locating service. Outages to isolate utility systems must be used in circumstances where utilities are unable to be positively identified. The use of historical drawings does not alleviate the contractor from meeting this requirement.

3.9 ELECTRICAL

A. Conduct of Electrical Work
   Underground electrical spaces must be certified safe for entry before entering to conduct work. Cables that will be cut must be positively identified and de-energized prior to performing each cut. Positive cable identification must be made prior to submitting any outage request for electrical systems. Arrangements are to be coordinated with the CA and utility company for identification. The CA will not accept an outage request until the Contractor satisfactorily documents that the circuits have been clearly identified. Perform all high voltage cable cutting remotely using hydraulic cutting tool. When racking in or live switching of circuit breakers, no additional person other than the switch operator will be allowed in the space during the actual operation. Plan so that work near energized parts is minimized to the fullest extent possible. Use of electrical outages clear of any energized electrical sources is the preferred method. When working in energized substations, only qualified electrical workers will be permitted to enter. When work requires Contractor to work near energized circuits as defined by the NFPA 70, high voltage personnel must use personal protective equipment that includes, as a minimum,

electrical hard hat, safety shoes, insulating gloves with leather protective sleeves, fire retarding shirts, coveralls, face shields, and safety glasses. In addition, provide electrical arc flash protection for personnel as required by NFPA 70E. Insulating blankets, hearing protection, and switching suits may also be required, depending on the specific job and as delineated in the Contractor's AHA.

B. Portable Extension Cords
Size portable extension cords in accordance with manufacturer ratings for the tool to be powered and protected from damage. Immediately remove from service all damaged extension cords. Portable extension cords shall meet the requirements of NFPA 70.

3.10 WORK IN CONFINED SPACES

A. Comply with the requirements in OSHA 29 CFR 1910.146 and OSHA 29 CFR 1926.21(b)(6). Any potential for a hazard in the confined space requires a permit system to be used.

1. Entry Procedures. Prohibit entry into a confined space by personnel for any purpose, including hot work, until the qualified person has conducted appropriate tests to ensure the confined or enclosed space is safe for the work intended and that all potential hazards are controlled or eliminated and documented. All hazards pertaining to the space shall be reviewed with each employee during review of the AHA.
2. Forced air ventilation is required for all confined space entry operations and the minimum air exchange requirements must be maintained to ensure exposure to any hazardous atmosphere is kept below its' action level.
3. Sewer wet wells require continuous atmosphere monitoring with audible alarm for toxic gas detection.

END OF SECTION 01 35 26

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Construction Documents and general provisions of the CMR Agreement Between Owner and Construction Manager and the Guaranteed Maximum Price (GMP) Amendment, including Division 00 General Conditions of the Contract for Construction – CMR and Supplementary Conditions and other Division 01 Specification Sections - CMR, apply to this Section.

1.2 DEFINITIONS

A. General: Basic contract definitions are included in the General Conditions of the Contract for Construction - CMR.

B. "Indicated": The term "indicated" refers to graphic representations, notes, or schedules on the Drawings, or other paragraphs or Schedules in the Specifications, and similar requirements in the Contract Documents. Terms such as "shown," "noted," "scheduled," and "specified" are used to help the reader locate the reference. Location is not limited to this term.

C. "Directed": Terms such as "directed," "requested," "authorized," "selected," "approved," "required," and "permitted" mean directed by the Architect, requested by the Architect, and similar phrases.

D. "Approved": The term "approved," when used in conjunction with the Architect's action on the Contractor's submittals, applications, and requests, is limited to the Architect's duties and responsibilities as stated in the Conditions of the Contract - CMR.

E. "Regulations": The term "regulations" includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.

F. "Furnish": The term "furnish" means supply and deliver to the Project Site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. "Install": The term "install" describes operations at the Project Site including the actual unloading, unpacking, assembly, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

H. "Provide": The term "provide" means to furnish and install, complete and ready for the intended use.

I. "Installer": An installer is the Subcontractor or another entity engaged by the CCMR, either as an employee, subcontractor, or contractor of lower tier, to perform a particular construction activity, including installation, erection, application, or similar operations. Installers are required to be experienced in the operations they are engaged to perform.

1. The term "experienced," when used with the term "installer," means having a minimum of five (5) previous projects similar in size and scope to this Project, being familiar with the special requirements indicated, and having complied with requirements of authorities having jurisdiction.

2. Trades: Using terms such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespersons of the corresponding generic name.

3. Assigning Specialists: Certain Sections of the Specifications require that specific construction activities shall be performed by specialists who are recognized experts in those operations. The specialists must be engaged for those activities, and their assignments are requirements over which the CMR has no option. However, the ultimate responsibility for fulfilling contract requirements remains with the Contractor.

a. This requirement shall not be interpreted to conflict with enforcing building codes and similar regulations governing the Work. It is also not intended to interfere with local trade-union jurisdictional settlements and similar conventions.

J. "Project Site" is the space available to the CMR for performing construction activities, either exclusively or in conjunction, with others performing other Work as part of the Project. The extent of the Project Site is shown on the Drawings and may or may not be identical with the description of the land on which the Project is to be built.

K. "Testing Agencies": A testing agency is an independent entity engaged to perform specific inspections or tests, either at the Project Site or elsewhere, and to report on and, if required, to interpret results of those inspections or tests.

1.3 SPECIFICATION FORMAT AND CONTENT EXPLANATION

A. Specification Format: These Specifications are organized into Divisions and Sections based on CSI's "MasterFormat" 49-Division format and numbering system.

B. Specification Content: This Specification uses certain conventions regarding the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations or circumstances. These conventions are explained as follows:

1. Abbreviated Language: Language used in Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be interpolated, as the sense requires. Singular words will be interpreted as plural and plural words interpreted as singular where applicable as the context of the Contract Documents indicates.

2. Streamlined Language: The Specifications generally use the imperative mood and streamlined language. Requirements expressed in the imperative mood are to be performed by the CMR. At certain locations in the Text, subjective language is used for clarity to describe responsibilities that must be fulfilled indirectly by the CMR or by others when so noted.

a. The words "shall be" are implied where a colon (:) is used within a sentence or phrase.

1.4 INDUSTRY STANDARDS

A. Applicability of Standards: Except where the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with the standards in effect as of the date of the Contract Documents unless a specific date is indicated in the Contract Documents or the governing regulations cited herein.

C. Conflicting Requirements: Where compliance with two (2) or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent and highest quality requirement. Request a decision from the Architect before proceeding on requirements that are different but apparently equal, and where it is uncertain which requirement is the most stringent.

1. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum acceptable. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of the requirements. Request a clarification from the Architect regarding uncertainties before proceeding.

D. Copies of Standards: Each entity engaged in construction on the Project is required to be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, the CMR shall obtain copies directly from the publication source.

E. Abbreviations and Names: Trade association names and titles of general standards are frequently abbreviated. Where such acronyms or abbreviations are used in the Specifications or other Contract Documents, they mean the recognized name of the trade association, standards-generating organization, authorities having jurisdiction, or other entity applicable to the context of the text provision. Refer to Thompson Gale's "Encyclopedia of Associations," available in most libraries.

1.5 GOVERNING REGULATIONS AND AUTHORITIES

A. Copies of Regulations: Obtain copies of the "latest applicable State Codes and Regulations" and the following regulations and retain at the Project Site to be available for reference by parties who have a reasonable need during submittals, planning, and progress of the Work, until Substantial Completion.

1. State Building Code/ 2005 Connecticut Supplement.
2. International Building Code/ 2003.
3. International Existing Building Code/ 2003.
4. International Mechanical Code/ 2003 with 2005 and 2009 Ct Amendments.
5. International Plumbing Code/ 2003 with 2005 and 2009 Ct Amendments.
6. International Energy Conservation Code/ 2009 with 2011 Ct Amendments.
7. National Electric Code NFPA 70/ 2005 with 2009 Ct Amendments.
8. Connecticut Fire Safety Code/ 2005 with 2009 Ct Amendments.
9. ICC/ANSI A117.1-Accessible and Usable Buildings and Facilities/ 2003.
10. NFPA 101/ 2003.
11. OSHA 29 CFR Part 1910 Occupational Safety and Health Regulations/1999.
12. OSHA 29 CFR Part 1926 Occupational Safety and Health Regulations for Construction/1999.

B. For a list of the "latest applicable State Codes and Regulations" and how they can be obtained see www.ct.gov/dcs (Connecticut Department of Construction Services website) and click on "Office of State Building Inspector" and also visit the www.ctdol.state.ct.us Connecticut Department of Labor website.

1.6 SUBMITTALS

A. Permits, Licenses, and Certificates: For the Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01 42 20

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Construction Documents and general provisions of the CMR Agreement Between Owner and Construction Manager and the Guaranteed Maximum Price (GMP) Amendment, including Division 00 General Conditions of the Contract for Construction – CMR and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for quality-control services.

B. Quality-Control services include fire alarm acceptance testing, inspections, tests, and related actions, including reports performed by Construction Manager, by independent agencies, and by governing authorities. They do not include contract enforcement activities performed by the Owner.

C. Inspection and testing services are required to verify compliance with requirements specified or indicated. These services do not relieve Construction Manager of responsibility for compliance with Contract Document requirements.

D. Requirements of this Section relate to customized fabrication and installation procedures, not production of standard products.

1. Specific quality-control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.

2. Specified inspections, tests, and related actions do not limit Construction Manager's quality-control procedures that facilitate compliance with Contract Document requirements.

3. Requirements for Construction Manager to provide quality-control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

E. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 01 Section 01 33 00 "Submittal Procedures - CMR" specifies requirements for development of a schedule of required tests and inspections.

2. Division 01 Section 01 73 29 "Cutting and Patching- CMR" specifies requirements for repair and restoration of construction disturbed by inspection and testing activities.

3. Division 01 Section 01 77 00 "Closeout Procedures- CMR", specific requirements for contract closeout procedures.

4. Division 28 Section 28 31 00 "Fire Detection and Alarm- CMR" specifies field quality control for the Alarm System.

1.3 RESPONSIBILITIES

A. Construction Manager Responsibilities: Unless otherwise indicated as the responsibility of another identified entity, the Owner, through the Owner’s Representative, shall provide inspections, tests, and other quality-control services specified elsewhere in the Contract Documents and required by authorities having jurisdiction. All tests required by the individual specification sections are required to be scheduled and notification given to the Owner’s Representative 24/48 hours in advance of the test/inspection as applicable. Costs for these services are not included in the Contract Sum.

1. Where individual Sections specifically indicate that certain inspections, tests, and other quality-control services are the Construction Manager's responsibility, the Construction

Manager shall employ and pay a qualified independent testing agency to perform quality-control services. Costs for these services are included in the Guaranteed Maximum Price.

2. Where individual Sections specifically indicate that certain inspections, tests, and other quality-control services are the Owner's responsibility, the Owner will employ and pay a qualified independent testing agency to perform those services.

a. Such services include Special Inspections as required by the latest edition of the "Connecticut State Building Code".

b. Where the Owner has engaged a testing agency for testing and inspecting part of the Work, and the Construction Manager is also required to engage an entity for the same or related element, the Construction Manager shall not employ the entity engaged by the Owner. The Owner will engage the services of a qualified Special Inspector for this project. The Special Inspector, as a representative of the Owner, shall document and confirm compliance with the provisions of the Connecticut State Building Code for Special Inspections.

c. Materials and assemblies for this project will be tested and construction operations inspected as the work progresses. Failure to detect any defective work or material shall not in any way prevent later rejection when such defect is discovered nor shall it obligate the State for final acceptance.

d. The Owner’s use of testing and inspection services shall in no way relieve the Construction Manager of the responsibility to furnish materials and finished construction in full compliance with the Contract Documents and the Connecticut State Building Code.

B. Retesting: The Construction Manager is responsible for retesting where results of inspections, tests, or other quality-control services prove unsatisfactory and indicate noncompliance with Contract Document requirements, regardless of whether the original test was Construction Manager 's responsibility.

1. The cost of retesting construction, revised or replaced by the Construction Manager, is the Construction Manager's responsibility where required tests performed on original construction indicated non-compliance with Contract Document requirements.

2. The Owner will issue a credit change order to cover all costs incurred related to all re-tests/re-inspections due to non-compliance to the Contract Documents, including but not limited to the Owner’s costs and the Consultant’s costs.

3. Costs incurred by the Owner and the Construction Manager due to excessive retesting and reinspections as a result of deficient work on the part of the subcontractor will be charged to the subcontractor.

4. All Work must be completed in compliance with the Construction Manager’s Construction Quality Control Program, particular attention is to be paid to Section IV: Subcontractors.

C. Associated Services: Cooperate with agencies performing required inspections, tests, and similar services, and provide reasonable auxiliary services as requested. Notify the Agency sufficiently in advance of operations to permit assignment of personnel. Auxiliary services required include, but are not limited to, the following:

1. Provide access to the Work.

2. Furnish incidental labor and facilities necessary to facilitate inspections and tests.

3. Take adequate quantities of representative samples of materials that require testing or assist the agency in taking samples.

4. Provide facilities for storage and curing of test samples.

5. Deliver samples to testing laboratories.

6. Provide an approved design mix proposed for use for material mixes that require control by the testing agency.

7. Provide security and protection of samples and test equipment at the Project Site.

D. Duties of the Testing Agency: The independent testing agency engaged to perform inspections, sampling, and testing of materials and construction specified in individual Sections shall cooperate with the Owner's Representative, Architect and the Construction Manager in performance of the testing agency's duties. The testing agency shall provide qualified personnel to perform required inspections and tests.

1. The testing agency shall notify the Owner's Representative and the Construction Manager promptly of irregularities or deficiencies observed in the Work during performance of its services.

2. The testing agency is not authorized to release, revoke, alter, or enlarge requirements of the Contract Documents or approve or accept any portion of the Work.

3. The testing agency shall not perform any duties of the Construction Manager.

E. Owner will pay for the services of an independent testing agency laboratory to perform inspections, tests and other services required by the Specifications except as noted below, listed for which the Owner will issue a deduct change order to cover the cost associated with these tests:

1. When the Construction Manager notifies the Owner's Representative and/or Testing Agency less than 24 hours before the expected time of testing.

2. When the Construction Manager requires testing for his own convenience.

3. When the Construction Manager schedules a test and is not ready for the required test.

F. Submit reports of tests that are part of the submittal requirements which indicate compliance or non-compliance with the specified standard.

G. See also Division 00 General Conditions of the Contract for Construction – CMR, Article 16 "Inspections & Tests".

H. Fire Alarm/Acceptance Testing Procedures:

1. The fire alarm testing shall be as the authority having jurisdiction shall dictate. This will be as determined by the State Fire Marshals Office.

i. Tests:

i. All tests shall be conducted in accordance with the Manufacturer's Testing Recommendations.

ii. All testing equipment, apparatus (i.e. sound level decibel meter, 2-way radio communication, test devices, ladders, tools, lighting, etc.) and personnel shall be supplied by the Fire Alarm Contractor and Sprinkler Contractor.

j. System Documentation: Every system shall include the following documentation, which shall be delivered to the Department of Construction Services Representatives upon final acceptance of the system. An owner's manual or manufacturer's installation instructions covering all system equipment, including the following:

i. A detailed narrative description of the system inputs, evacuation signaling, ancillary functions, annunciation, intended sequence of operations, expansion capability, application considerations, and limitations.

ii. Operator's instructions for basic systems operations including alarm acknowledgment, system reset, interpreting system output (LED's CRT display, and printout), operation of manual evacuation signaling and ancillary function controls, changing printer paper, etc.

iii. A detailed description of routine maintenance and testing as required and recommended and as would be provided under a maintenance contract, including testing and maintenance instructions for each type of device installed. This information should include:

(a) A listing of individual system components that require periodic testing and maintenance.

(b) Step by step instructions detailing the requisite testing and maintenance procedures and the intervals at which those procedures should be performed.

(c) A schedule that correlates the testing and maintenance procedures required by paragraph (2) above and with the listing required by paragraph (1) above.

iv. Detailed troubleshooting instructions for each type of trouble condition recognized by the system, including opens, grounds, parity errors, "loop failures," etc. These instructions should include a list of all trouble signals, and step by step instructions describing how to isolate those problems and correct them (or call for service as appropriate).

v. A service directory, including a list of names and telephone numbers for those who should be called to service the system.

f. As-Built Drawings:

1. The Construction Manager will produce two (2) sets of as-built drawings and specifications for the fire alarm system, indicating the location (and programmed address, if applicable) of all devices and appliances, the wiring sequences, wiring methods, connection of the components, and sequence of operation of the protective signaling system as installed, shall be given to CTDPW representatives. This shall be in Accordance with NFPA 72. Refer also to Section 01 77 00 "Closeout Procedures - CMR".

1.4 SUBMITTALS

A. Unless the Construction Manager is responsible for this service, the independent testing agency shall submit a certified written report, in duplicate, of each inspection, test, or similar service to the Owner's Representative. If the Construction Manager is responsible for the service, submit a certified written report, in duplicate, of each inspection, test, or similar service through the Construction Manager.

1. Submit additional copies of each written report directly to the governing authority, when the authority so directs.

2. Report Data: Written reports of each inspection, test, or similar service include, but are not limited to, the following:

a. Date of issue.

b. Project title and number.

c. Name, address, and telephone number of testing agency.

d. Dates and locations of samples and tests or inspections.

e. Names of individuals making the inspection or test.

f. Designation of the Work and test method.

g. Identification of product and Specification Section.

h. Complete inspection or test data.

i. Test results and an interpretation of test results.

j. Ambient conditions at the time of sample taking and testing.

k. Comments or professional opinion on whether inspected or tested Work complies with Contract Document requirements.

l. Name and signature of laboratory inspector.

m. Recommendations on re-testing.

1.5 QUALITY ASSURANCE

A. Qualifications for Service Agencies: Engage inspection and testing service agencies, including independent testing laboratories, that are pre-qualified as complying with the National Voluntary Laboratory Accreditation Program and that specialize in the types of inspections and tests to be performed.

1. Each independent inspection and testing agency engaged on the Project shall be authorized by authorities having jurisdiction to operate in the state where the Project is located.

B. Mockups: Provide full-size, physical assemblies that are constructed on-site. Mockups will be used to verify selections made under sample submittals, to demonstrate aesthetic effects and, where indicated, qualities of materials and execution, and to review construction, coordination, testing, or operation; they are not samples. [Approved mockups establish the standard by which the Work will be judged.]

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 MOCKUPS

A. Build site-assembled mockups using installers who will perform same tasks for project.

B. Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.

2. Notify Architect and Owner’s Representative seven (7) days in advance of dates and times when mockups will be constructed.

3. Demonstrate the proposed range of aesthetic effects and workmanship.

4. Obtain Architect's and Owner’s Representative approval of mockups before starting work, fabrication, or construction.

5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.

6. Demolish and remove mockups when directed, unless otherwise indicated.

3.2 REPAIR AND PROTECTION

A. General: Upon completion of inspection, testing, sample taking and similar services, repair damaged construction and restore substrates and finishes. Comply with Contract Document requirements for Division 01 Section 01 73 29 "Cutting and Patching - CMR."

B. Protect constructions exposed by or for quality-control service activities, and protect repaired construction.

C. Repair and protection is Construction Manager's responsibility, regardless of the assignment of responsibility for inspection, testing, or similar services.

END OF SECTION 01 45 00 - CMR

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Construction Documents and general provisions of the CMR Agreement Between Owner and Construction Manager and the Guaranteed Maximum Price (GMP) Amendment, including Division 00 General Conditions of the Contract for Construction – CMR and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Requirements of baseline Indoor Air Quality (IAQ) testing for maximum indoor pollutant concentrations for acceptance of the facility.
2. Requirements for independent materials testing of specific materials anticipated to have major impact on IAQ.
3. Procedures for testing specific construction materials for IAQ performance to assure compliance with green building rating system credits. Materials have been identified for independent testing based on the following three (3) criteria:
   a. Large volume of material used in occupied spaces.
   b. The space is occupied during normal working hours.
   c. Materials are used in an area where there is recirculating air.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Divisions 01 through 49 sections for green building rating system requirements specific to the Work of each of those sections. These requirements may or may not include reference to LEED or Green Globes.
2. Division 23 Section 23 05 93 "Testing, Adjusting and Balancing for HVAC" for additional requirements for baseline testing for IAQ.
3. Division 23 Section 23 05 93 "Testing, Adjusting and Balancing for HVAC" for cleaning of HVAC system including duct work, air intakes and returns, and changing of filters.

1.3 REFERENCES

A. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE):

1. ASHRAE 52.2-1999, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.

B. ASTM International, Inc. (ASTM):

1. ASTM D5116-2006, Standard Guide for Small-Scale Environmental Chamber Determinations of Organic Emissions From Indoor Materials/Products.

C. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):

1. IAQ Guidelines for Occupied Buildings Under Construction, 1995.

D. United States Environmental Protection Agency (EPA):

1. Compendium of Methods for the Determination of Air Pollutants in Indoor Air.

1.4 SUBMITTALS

A. Baseline IAQ Testing: Submit a report for each test site specified for IAQ baseline testing as prescribed in Section 23 05 93 "Testing, Adjusting and Balancing for HVAC". Report on air concentrations of targeted pollutants as identified in Table 3.1 below.

B. Product Emissions Test Reports: Submit a report for each material emissions test performed. Report test results in terms of emission factors that will be used by the Owner to model indoor air concentrations. These reports and the modeling data prepared by the Owner shall be included in the closeout documentation specified in Section 01 77 00 "Closeout Procedures - CMR".

C. Green Building Certification Documentation Submittals:

1. Construction Indoor Air Quality (IAQ) Management Plan (During Construction) Credit:

a. Construction IAQ management plan.

b. Letter confirming if the permanently installed air handling equipment was used during construction.

c. Product data for temporary filtration media. Indicate manufacturer, model number, MERV rating, and location of installed media.

d. Letter confirming that each filtration media was replaced prior to final occupancy.

e. Product data for filtration media to be used during occupancy. Indicate manufacturer, model number, MERV rating, and location of media.

f. Construction Documentation: Six (6) photographs at three (3) different occasions during construction along with a brief description of the SMACNA approach employed, document implementation of the IAQ management measures, such as protection of ducts and on-site stored or installed absorptive materials.

2. Construction Indoor Air Quality (IAQ) Management Plan (Before Occupancy) Credit:

a. Signed letter confirming the approach taken by the project (pre-occupancy flush-out; flush-out with early occupancy flush-out or IAQ testing).

b. A narrative describing the building air flush-out procedures including the dates when flush-out was begun and completed and statement that filtration media was replaced after flush-out.

c. Product data for filtration media used during flush-out and during occupancy.

d. A narrative describing the building's IAQ testing process and results including the dates when testing was started and completed.

e. Report from testing and inspecting agency indicating results of IAQ testing and documentation showing conformance with IAQ testing procedures and requirements.

1.5 QUALITY ASSURANCE

A. Perform material tests and report results in accordance with ASTM D5116.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 BASELINE IAQ TESTING

A. HVAC System Verification: To assure compliance with recognized standards for indoor air quality including ASHRAE 62-2004, the Construction Manager's independent testing and balancing agency shall verify the performance of each HVAC system including space temperature and space humidity uniformity, outside air quantity, filter installation, drain pan operation, and any obvious contamination sources.

B. Indoor Air Quality Testing: Upon verification of HVAC system operation, the Construction Manager shall hire an independent subcontractor, subject to approval by the Architect, with a minimum of five (5) years experience in performing the types of testing specified herein, to test levels of indoor air contaminants for compliance with specified requirements.

1. Submit a test plan for the approval of the Architect. The plan shall specify procedures, times, instrumentation, and sampling methods that will be employed.
2. Perform testing in 16 different locations. Contaminant levels are to be measured on each floor of each building in an area agreed upon by the Construction Manager and the Architect. Areas with very high outside air ventilation rates such as laboratories are excluded from these testing requirements. The Architect is the sole judge of areas exempt from testing.
3. Collect air samples on three (3) consecutive days during normal business hours (between the hours of 8:00 AM and 5:00 PM) with building operating at normal HVAC rates. Average the results of each three-day test cycle to determine compliance or non-compliance of indoor air quality for each air handling zone tested.
4. Sample and record outside air levels of formaldehyde and TVOC contaminants at outside air intake of each respective air handling unit simultaneously with indoor tests to establish basis of comparison for these contaminant levels. Indoor testing will be done in the breathing zone; between four (4) and seven (7) feet from the floor.
5. Acceptance of respective portions of [the building] [buildings] by the Architect is subject to compliance with specified limits of indoor air quality contaminant levels.

C. Compliance indoor air quality shall conform to the following standards and limits:
1. Carbon Monoxide: Not to exceed nine (9) ppm.
2. Carbon Dioxide: Not to exceed 800 ppm.
3. Airborne Mold and Mildew: Simultaneous indoor and outdoor readings.
4. Maximum Air Concentration Standards: Indoor room air concentration levels, emission rates, and qualities of the listed contaminants shall not exceed the following limits specified in Table 3.1 below.

D. Test Reports: Prepare test reports showing the results and location of each test, a summary of the HVAC operating conditions, a listing of any discrepancies and recommendations for corrective actions, if required.
1. Include certification of test equipment calibration with each test report.

E. If any test fails the standard, the Construction Manager is responsible to ventilate the building with 100 percent outside air until the building passes both air quality tests and duct inspections. Retesting shall be performed at no additional expense to the Owner.

Table 3.1 MAXIMUM INDOOR AIR CONCENTRATION STANDARDS

INDOOR CONTAMINANTS	MAXIMUM AIR CONCENTRATION LEVELS*
Formaldehyde	50 parts per billion
Particulates (PM10)	50 micrograms per cubic meter
Total Volatile Organic Compounds (TVOC)	500 micrograms per cubic meter
4-Phenylcyclohexene (4-PCH)**	6.5 micrograms per cubic meter
Carbon Monoxide (CO)	9 parts per million and no greater than 2 parts per million above outdoor levels

* All levels must be achieved prior to acceptance of the building. The levels do not account for contributions from office furniture, occupants, and occupant activities.

** This test is only required if carpet and fabrics with styrene-butadiene rubber (SBR) latex backing material are installed in the building.

F. Construction Indoor Air Quality (IAQ) Management Plan (During Construction) Credit: Comply with SMACNA IAQ Guidelines for Occupied Buildings under Construction.

G. Construction Indoor Air Quality (IAQ) Management Plan (After Construction) Credit:

1. After construction ends, prior to occupancy and with all interior finishes installed, perform a building flush-out by supplying a total air volume of 14000 cu ft of outdoor air per sq ft of floor area while maintaining an internal temperature of at least 60 degrees F and relative humidity no higher than 60 percent.
   a. Refer to Section 01 57 40 - Construction Indoor Air Quality (IAQ) Management Plan.
2. If building occupancy is to occur before completion of the flush-out, deliver a minimum of 3500 cu ft of outdoor air per sq ft of floor area to the space. Once the space is occupied, ventilate it at a minimum rate of 0.30 cfm/sq ft of outside air or the design minimum outside air rate determined in accordance with Sections 4 through 7 of ASHRAE 62.1 or applicable local code, whichever is more stringent. During each day of the flush-out period, begin ventilation a minimum of three (3) hours prior to occupancy and continue during occupancy. Maintain these conditions until a total of 14000 cu ft/sq ft of outside air has been delivered to the space.
3. Engage an independent testing and inspecting agency to conduct a baseline IAQ testing program according to EPA Compendium of Methods for the Determination of Air Pollutants in Indoor Air and the LEED for New Construction Version 2.2 Reference Guide.

3.2 INDEPENDENT MATERIALS TESTING

A. Materials That Must Be Tested: Test materials listed below that are proposed for use on this project for permanent, in-place Indoor Air Quality performance in accordance with requirements of these specifications. Results shall be furnished to the Architect. Materials meeting the criteria for independent testing are as follows:
   1. Field applied paint systems on appropriate substrate. Paint primers and intermediate coats (if used) should be applied with a typical drying time allowed between coats (not to exceed seven (7) days).
   2. Carpet including the manufacturer's recommended adhesive. The carpet will be applied to the appropriate concrete flooring per manufacturer's instructions so that the testing is of the "carpet assembly."
   3. Acoustical ceiling tile.
   4. Fireproofing material applied to appropriate substrate.

B. Materials for Testing: Only test representative samples of actual products selected for use on this project. Tests of products generically and/or technically similar but produced by a manufacturer other than that of the product selected for use on this project is invalid.

C. Materials Testing Parameters:
   1. Wrap each material to be tested in air tight covering for shipment direct from the factory to the testing laboratory to avoid contamination in transit. Unwrap material or apply material to substrate if material is wet-applied, such as paint or adhesive materials) in the testing lab.
   2. Emissions Testing: Perform all testing in accordance with ASTM D5116. Report results in accordance with Section ii of referenced ASTM Standard. Report in terms of emission rates at a minimum of three (3) distinct time intervals (e.g., one (1) hour, 24 hours, 72 hours) that will be modeled by the Architect to predict maximum indoor air concentrations and to assist the Construction Manager in determining suitability of products or materials. Assumptions that will be used for the Architect's model are given below for information.
   3. Table 3.2 summarizes required product testing.

Table 3.2 PRODUCT EMISSION TESTING

PRODUCT ASSEMBLY TO BE TESTED	TVOC (per ASTM)	PM (per NIOSH)
Wall paint on appropriate substrate, including any primer coat	Yes	No

Carpet including adhesive and concrete flooring	Yes	No
Acoustical Ceiling Tile	No	Yes
Fireproofing material on appropriate substrate	No	Yes

D. Model Assumptions Used for Predicting Indoor Air Concentrations: The model will assume the standard room enclosure as 10' long x 10' wide x 9' high. Each product tested will be modeled separately to provide information on the particular product. The model will assume a ventilation rate of one (1) air change per hour.

1. Field Applied Paint Systems: Test fully cured samples of each complete paint system including primers, intermediate coats (if used), and finish coats. The model assumes application to all four (4) walls and one-half of ceiling of model standard room enclosure.
2. Carpet and Adhesive Assembly: Assumes application to entire 10 x 10 ft floor surface of model standard room enclosure.
3. Acoustical Ceiling Tile: Assumes application to entire 10 x 10 ft ceiling surface of model standard room enclosure.
4. Fireproofing: Assumes application to entire 10 x 10 ft area above the ceiling surface of model standard room enclosure.

E. Materials Test Reports: Submit test reports to the Architect. The report shall include the information outlined in Section 11 of ASTM D5116.

F. Product/Material Evaluation: All products/materials shown by testing to comply with emissions limits and other criteria specified in this section will be approved for use on this project subject to compliance with all other specified requirements of the Project Manual. Products/materials shown by model to exceed specified emission limits shall be discussed, test results interpreted, and a determination made as to alternative product uses or selections.

END OF SECTION 01 45 23.13 - CMR

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Construction Documents and general provisions of the CMR Agreement Between Owner and Construction Manager and the Guaranteed Maximum Price (GMP) Amendment, including Division 00 General Conditions of the Contract for Construction – CMR and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes requirements for identification badges, parking stickers, construction facilities and temporary controls, including temporary utilities, support facilities, and security and protection.

B. Temporary utilities include, but are not limited to, the following:

1. Temporary water service and distribution.

2. Temporary electric power and lighting services.

3. Temporary heating, cooling and ventilation

4. Temporary telephone service and data.

5. Temporary sanitary facilities, including drinking water.

6. Storm and sanitary sewer.

7. Storm water pollution control.

C. Support facilities include, but are not limited to, the following:

1. Field offices –Construction Manager, Subcontractor, Owner, and Owner's Representative.

2. Storage and fabrication sheds.

3. Temporary roads and paving.

4. Dewatering facilities and drains.

5. Temporary enclosures.

6. Temporary lifts, hoists and elevator use.

7. Temporary project identification signs.

8. Temporary exterior lighting.

9. Collection and disposal of waste and cleaning.

10. Temporary Environmental Controls.

11. Stairs.

D. Security and protection facilities include, but are not limited to, the following:

1. Temporary fire protection.

2. Permanent fire protection.

3. Security for site and Agency.

4. Barricades, warning signs, and lights.

5. Enclosure fence.

6. Security enclosure and lockup.

7. Protection.

8. Environmental protection.

9. Traffic ways.

10. Identification badges for Construction Manager's personnel & parking stickers.

1.3 RELATED SECTIONS

A. Division 01 Section 01 57 30 "Indoor Environmental Control - CMR" for additional provisions governing temporary heating, ventilating and air conditioning.

1.4 SUBMITTALS

A. Temporary Utilities: Submit reports of tests, inspections, meter readings, and similar procedures performed on temporary utilities.

B. Implementation and Termination Schedule: Within twenty-one (21) days of the date established for commencement of the Work, submit a schedule indicating implementation and termination of each temporary utility.

1.5 QUALITY ASSURANCE

A. Regulations: Comply with industry standards and applicable laws and regulations of authorities having jurisdiction including, but not limited to, the following:

1. Building and fire code requirements.

2. Health and safety regulations.

3. Utility company regulations.

4. Police, fire department, and rescue squad rules.

5. Environmental protection regulations.

6. Americans with Disabilities Act.

B. Standards: OSHA. Comply with NFPA 241 "Standard for Safeguarding Construction, Alteration, and Demolition Operations," ANSI A10 Series standards for "Safety Requirements for Construction and Demolition," and NECA 200 "Recommended Practice for Installing and Maintaining Temporary Electric Power at Construction Sites."

1. Electrical Service: Comply with NEMA, NECA, and UL standards and regulations for temporary electric service. Install service in compliance with NFPA 70 "National Electric Code."

C. Inspections: Arrange for authorities having jurisdiction to inspect and test each temporary utility before use. Obtain required certifications and permits.

1.6 PROJECT CONDITIONS

A. Temporary Utilities: Prepare a schedule indicating dates for implementation and termination of each temporary utility. At the earliest feasible time, when acceptable to the Owner, the Owner's Representative and CT Department of Construction Services (CT DCS) PM will direct the change over from use of temporary service to use of permanent service.

B. Conditions of Use: Keep temporary services and facilities clean and neat in appearance. Operate in a safe and efficient manner. Relocate temporary services and facilities as the Work progresses. Do not overload facilities or permit them to interfere with progress. Take necessary fire-prevention measures. Do not allow hazardous, dangerous, or unsanitary conditions, or public nuisances to develop or persist on-site.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Provide new materials. If acceptable to the Architect, the Construction Manager may use undamaged, previously used materials in serviceable condition. Provide materials suitable for use intended.

B. Lumber and Plywood: Comply with requirements in Division 06 Section 06 10 00 "Rough Carpentry."

1. For signs and directory boards, provide 3/4-inch exterior grade, Grade A-B Fir plywood. Mount sign on preservative treated Fir posts.

a. Project sign shall be 4' x 8' painted and supported on 4-inch x 4-inch posts, of a design to be provided by the Owner via the Owner's Representative and CT DCS PM.

2. Vision Barriers: Provide minimum 1/2-inch thick exterior plywood.

3. For safety barriers, sidewalk bridges, and similar uses, provide minimum 5/8-inch thick exterior plywood.

C. Paint: Comply with requirements of Division 09 Section 09 91 00 "Painting."

1. For sign and directory boards applying graphics, provide exterior-grade alkyd gloss enamel over exterior primer unless otherwise indicated.

D. Tarpaulins: Provide waterproof, fire-resistant, UL-labeled tarpaulins with flame-spread rating of 15 or less. For temporary enclosures, provide translucent, nylon-reinforced, laminated polyethylene or polyvinyl chloride, fire-retardant tarpaulins.

E. Water: Provide potable water approved by local health authorities.

F. Provide potable water approved by local health authorities.

G. Enclosure Fencing: Provide 0.120-inch thick, galvanized 2-inch chain link fabric fencing six (6) feet high galvanized steel pipe posts, 1-1/2 inches knuckle both bottom and top I.D. for line posts and 2-1/2 inches I.D. for corner posts.

2.2 EQUIPMENT

A. General: Provide new equipment. If acceptable to the Architect, the Construction Manager may use undamaged, previously used equipment in serviceable condition. Provide equipment suitable for use intended.

1. The Construction Manager shall furnish tools, apparatus and appliances, hoists and/or cranes and power for same, scaffolding, runways, ladders, temporary supports and bracing and similar work or material necessary to insure convenience and safety in the execution of the Contract except where this is otherwise specified in any Specification Section. All such items shall meet the approval of the Owner but responsibility for design, strength and safety shall remain with the Construction Manager. All such items shall comply with Federal OSHA regulations and applicable codes, statutes, rules and regulations, including compliance with the requirements of the current edition of the "Manual of Accident Prevention in Construction" published by the Associated General Contractors (AGC) and the standards of the State Labor Department.

2. Staging, exterior and interior, required for the execution of this Contract, shall be furnished, erected, relocated if necessary and removed by the Construction Manager. Staging shall be maintained in a safe condition without charge to and for the use of all trades as needed.

B. Water Hoses: Provide 3/4-inch, heavy-duty, abrasion-resistant, flexible rubber hoses with pressure rating greater than the maximum pressure of the water distribution system. Provide adjustable shutoff nozzles at hose discharge and backflow preventers.

C. Electrical Outlets: Provide properly configured, NEMA-polarized outlets to prevent insertion of 110- to 120-Volt plugs into higher voltage outlets. Provide receptacle outlets equipped with ground-fault circuit interrupters, reset button, and pilot light for connection of power tools and equipment.

D. Electrical Power Cords: Provide grounded extension cords. Use hard-service cords where exposed to abrasion and traffic. Provide waterproof connectors to connect separate lengths of electric cords if single lengths will not reach areas where construction activities are in progress. Do not exceed safe length-voltage ratio.

E. Lamps and Light Fixtures: Provide general service incandescent lamps of wattage required for adequate illumination. Provide guard cages or tempered-glass enclosures where exposed to breakage. Provide exterior fixtures where exposed to moisture.

F. Heating Units: Provide temporary heating units that have been tested and labeled by UL, FM, or another recognized trade association related to the type of fuel being consumed.

G. Temporary Field Offices: Provide prefabricated or mobile units with lockable entrances, operable windows, and serviceable finishes. Provide heated and air-conditioned units on foundations adequate for normal loading.

H. Temporary Toilet Units: The Agency will allow the toilets located in [Insert] for Construction Manager's use. If others are needed, provide self-contained, single-occupant toilet units of the chemical, aerated recirculation, or combustion type. Provide units properly vented and fully enclosed with a glass-fiber-reinforced polyester shell or similar nonabsorbent material.

I. Fire Extinguishers: Provide hand-carried, portable, UL-rated, Class A fire extinguishers for temporary offices and similar spaces. In other locations, provide hand-carried, portable, UL-rated, Class ABC, dry-chemical extinguishers or a combination of extinguishers of NFPA-recommended classes for the exposures.

1. Comply with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Use qualified personnel for installation of temporary facilities. Locate facilities where they will serve the Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required.

B. Provide each facility ready for use when needed to avoid delay. Maintain and modify as required. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

C. Storm Water Pollution Control:

1. Assume responsibility for storm water pollution control by submitting to the Connecticut Department of Environmental Protection (DEP) a "General Permit for the Discharge of Stormwater and Dewatering Wastewaters from Construction Activities" registration; conform to the permit requirements.

2. Conform to the Stormwater Pollution Control Plan included in the Contract Documents or use another plan, prepared at the Construction Manager's expense, which has been approved by the Owner and the Connecticut Department of Environmental Protection.

3. The "General Permit for the Discharge of Stormwater and Dewatering Wastewater from Construction Activities" "draft" registration is attached to the technical Section [Insert] Stormwater Pollution Control.

4. Sign and cause to be signed by each appropriate subcontractor, the Certification Statement required by the General Permit.

5. Provide, maintain, and monitor a rain gauge on the site; monitoring shall include maintaining a log of the readings. The rain gauge shall remain the property of the Construction Manager.

3.2 TEMPORARY UTILITY INSTALLATION

A. General: Engage the appropriate local utility company to install temporary service or connect to existing service. Where company provides only part of the service, provide the remainder with matching, compatible materials and equipment. Comply with company recommendations.

1. Arrange with company and existing users for a time when service can be interrupted, if necessary, to make connections for temporary services.

2. Provide adequate capacity at each stage of construction. Prior to temporary utility availability, provide trucked-in services.

3. Obtain easements to bring temporary utilities to the site where the Owner's easements cannot be used for that purpose.

4. Use Charges: If cost or use charges for temporary facilities are specified by this section to be borne by the Owner the cost or use charges for temporary facilities will be borne not longer than 30 days after final acceptance of the project.

B. Temporary Water Service and Distribution:

1. Install water service and distribution piping of sizes and pressures adequate for construction until permanent water service is in use.

a. Sterilization: Sterilize temporary water piping prior to use.

2. Water for construction purposes may be taken from the existing service. The Construction Manager shall provide connections, approved backflow prevention device, meter and pipe to the water main or nearest hydrant, subject to the approval of the Owner. Upon completion of work, the Construction Manager shall remove the temporary connections and backfill if necessary. If new water service is installed before construction is complete, the new system may be used provided it is returned to the Owner in as-new condition. The Construction Manager shall pay for the water used, as metered.

2. Connect to existing facilities, through an approved backflow prevention device; extend branch piping with outlets so that water is available by use of hoses. Owner will pay for water used. The Construction Manager shall not waste water or use faulty equipment. The Construction Manager shall provide, at his own expense, all connections, extensions and other apparatus required for use of such services. Upon completion of the Contract, the Construction Manager shall disconnect temporary extensions and return utility to its original condition.

C. Temporary Electric Power and Lighting Services:

1. Power and lighting may be taken from the power company's nearest pole with temporary poles, if needed, to extend the line to project. If permanent power lines have been installed before beginning project, then temporary lines can be brought in from the last pole.
2. Provide service required for construction with branch wiring and distribution boxes located to provide power and lighting by construction-type extension cords. Meter shall be provided and installed by the Construction Manager.
3. The Construction Manager shall pay all costs of temporary power and light.
4. Power Distribution System: Install wiring overhead and rise vertically where least exposed to damage. Where permitted, wiring circuits not exceeding 125 Volts, ac 20 Ampere rating, and lighting circuits may be nonmetallic sheathed cable where overhead and exposed for surveillance.
5. Temporary Lighting: When overhead floor or roof deck has been installed, provide temporary lighting with local switching. Install and operate temporary lighting that will fulfill security and protection requirements without operating the entire system. Provide temporary lighting that will provide adequate illumination for construction operations and traffic conditions.

D. Temporary Heating, Cooling and Ventilating:

1. Provide temporary heat required by construction activities for curing or drying of completed installations or for protection of installed construction from adverse effects of low temperatures or high humidity. Select safe equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce the ambient condition required and minimize consumption of energy.
   - **a.** Heating Facilities: Except where the Owner authorizes use of the permanent system, provide vented, self-contained, LP-gas or fuel oil heaters with individual space thermostatic control.
   - **b.** Use of gasoline-burning space heaters, open flame, or salamander heating units is prohibited.
2. Provide temporary heat during construction for interior areas included in the Contract to counteract low temperatures or excessive dampness. Maintain during said period or periods until final completion of the Contract, unless otherwise approved by the Owner in writing. Windows, doors, ventilators and similar openings shall be temporarily closed. Provide heat and ventilation to maintain specified conditions for construction operations and to protect materials and finishes from damage by temperature or humidity. The permanent heating system is not to be used for temporary heating unless approved, in writing, by the Owner. If approved, use of the permanent heating system by the Construction Manager does not constitute beneficial use by the Owner. The warrantee for said system will not commence until Substantial Completion is granted. Costs shall be paid by the Construction Manager. See individual Sections for temperature/humidity limits. Temporary heating methods shall comply with OSHA regulations and other applicable codes, statutes, rules and regulations and shall be approved by the Architect/Engineer and Owner.
3. Permanent air handling equipment, when used for temporary heating, shall be equipped with disposable "construction" filters. The construction filters shall have an average efficiency at least equal to the filters specified under Division 23, but not less than 30 percent when tested in accordance with ASHRAE 52.2 "Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size." The filters shall have an average arrestance of not less than 90 percent efficiency on one (1) micron size particles. Before turning over the system for final acceptance, the Construction Manager shall remove and dispose of the construction filters; clean the ductwork; spray clean the heating and cooling coils, and drain pans to "like new" condition; and install the filters specified in Division 23 Section 23 40 00 "HVAC Air Cleaning Devices."
4. The Construction Manager may use the existing heating system with temporary extensions, radiators or unit heaters, but such use is subject to the Owner's approval. Coordinate use of existing facilities with Owner. Provide additional, temporary extensions and units to satisfy the criteria given in the preceding paragraph. Owner will pay cost of energy used. Take measures to conserve energy. At the termination of construction, return the facilities to their original condition. Before operation of permanent facilities, verify that installation is approved for operation and that filters are in place.
5. Steam from the Agency's lines shall be metered and paid for by the Contractor at a price approved by the Agency and Owner. The Contractor shall arrange with his Heating Subcontractor to install and maintain temporary piping, radiators or unit heaters, reducing valves, steam traps and other necessary fittings and accessories. Traps shall be provided to prevent steam from entering main returns. The temporary layout shall meet the approval of the Architect/Engineer. Condensate meter (or meters) shall be installed to record usage of steam.

[Steam from the Agency's lines will be furnished to the Contractor without cost, but may be discontinued if use is unreasonable or wasteful.] At the termination of construction, return the facilities to their original condition.

6. Refer to Section 01 57 30 “Indoor Environmental Control – CMR” for additional requirements regarding means and methods of providing temporary heating, cooling and ventilating. Meet manufacturer’s standards for minimum and maximum temperatures and humidity governing installation of materials and systems.

E. Temporary Telephone Service and Data: Provide temporary telephone service throughout the construction period for all personnel engaged in construction activities. Install telephone on a separate line for each temporary office and first aid station. Construction Manager shall provide telephone service in his office and separate telephone service in the CT DCS Office and Owner’s Representative’s Office, if provided. It is preferred that the Construction Manager use a cellular phone. Basic service and local calls will be paid for by the Construction Manager. Toll calls will be paid for by the respective users.

1. Separate Telephone Lines: Provide additional telephone lines for the following:

a. Where an office has more than two (2) occupants, install a telephone for each additional occupant or pair of occupants.

b. Provide dedicated telephone lines for a separate fax machine in both the Construction Manager’s office and the CT DCS/OR office.

2. At each telephone, post a list of important telephone numbers.

F. Temporary Sanitary Facilities, Including Drinking Water: Temporary sanitary facilities include temporary toilets, wash facilities, and drinking-water fixtures. Comply with regulations and health codes for the type, number, location, operation, and maintenance of fixtures and facilities. Install where facilities will best serve the Project's needs.

1. Provide toilet tissue, wash basins with water, soap and paper towels, paper cups, and similar disposable materials for each facility. Provide covered waste containers for used material. The Construction Manager shall maintain the facilities in a sanitary condition.

2. Toilets: The Construction Manager shall install self-contained chemical toilet units. Shield toilets to ensure privacy. Use of pit-type privies will not be permitted. Provide separate facilities for male and female personnel.

3. Water Coolers: Where power is accessible, provide electric hot/cold water coolers to maintain dispensed cold water temperature at 45 to 55 degrees F. Provide bottled water service and cup supplies and maintain in a clean sanitary condition.

G. Storm and Sanitary Sewer: If sewers are available, provide temporary connections to remove effluent that can be discharged lawfully.

1. Filter out excessive amounts of soil, construction debris, chemicals, oils, and similar contaminants that might clog sewers or pollute waterways before discharge.

2. Connect temporary sewers to the municipal system, as directed by sewer department officials.

3. Maintain temporary sewers and drainage facilities in a clean, sanitary condition. Following heavy use, restore normal conditions promptly.

H. Storm Water Pollution Control: Provide earthen embankments and similar barriers in and around excavations and sub-grade construction, sufficient to prevent flooding by runoff of storm water from heavy rains.

3.3 SUPPORT FACILITIES INSTALLATION

A. General: Locate field offices, storage sheds, and other temporary construction and support facilities in designated area as shown on the Contract Documents. The location of the trailers on the Drawings is diagrammatic in nature. Final placement of the trailers is to be approved by the Owner’s Representative and CT DCS PM.

1. Maintain support facilities until Final Completion. Remove prior to Final Completion with permission from the Owner.

B. Field Offices: Provide insulated, weathertight temporary offices of sufficient size to accommodate required office personnel at the Project Site. Keep all offices clean and orderly, sweep weekly and remove rubbish on a daily basis. Furnish and equip offices as follows:

1. The Construction Manager shall provide an office for their own use and a method to contact them by e-mail and telephone at any point and time.

2. Construction Manager Provided Field Offices/Equipment: The Construction Manager shall provide an office for their own use and a method to contact them by e-mail and telephone at any point and time. The Construction Manager shall supply the Owner's Representative and the Owner office or trailer(s) with a water cooler for hot and cold water.

2. The Construction Manager shall provide a field office, for the sole use of the Owner's Representative and the Owner; (1) one double-wide trailer 24' x 60' including connector <u>or</u> (2) 12' x 60' trailers with connector. The trailer shall be in "new condition" as determined by the Construction Administrator. The trailer shall have a minimum of three (3) offices (minimum 150 square feet each), a main meeting area and a sound insulated toilet room, sink and hot and cold running water. The trailers shall have ample natural light, heating of sufficient capacity to maintain 70 degrees F in winter and air conditioning of sufficient capacity to maintain 75 degrees F in summer. The operational noise level of the supplied HVAC systems shall be low enough so as not to impede the conducting of meetings. The Construction Manager shall provide a 5-lb ABC fire extinguisher and an OSHA approved first aid kit. The Construction Manager shall provide the following furniture, which will remain his property. The furniture may be used but shall be in good condition as judged by the Construction Administrator. The Construction Manager shall supply the Owner's Representative and the Owner office or trailer(s) with a water cooler for hot and cold water.

2.1 The Construction Manager shall provide a lockable chemical toilet(s) with toilet tissue for the owners' use. The Construction Manager shall maintain the facility in a sanitary condition. (See Section 01 52 19 Temporary Sanitary Facilities).
2.2 Four (4) Lockable, double-pedestal, office desks, each with an executive chair.
2.3 Four (4) Plan tables.
2.4 Two (2) Plan racks.
2.5 Twenty (20) Conference chairs and a conference table (approx. 5 feet x 12 feet).
2.6 Four (4) Side tables (approx. 3 feet x 5 feet).
2.7 Four (4) Wall mounted, cork display boards (4 foot x 6 foot).
2.8 Two (2) Wall mounted, white, wipe-off board, with markers (3 foot x 4 foot).
2.9 Eight (8) File cabinets (lockable four drawer letter size).
2.10 Four (4) Bookshelves each with 10 linear feet x 12 inch wide shelving.
2.11 Four (4)Large capacity waste receptacles.
2.12 One (1) Plain paper, Fax Machine with dedicated telephone line approved by Owner.
2.13 Four (4) Telephones with telephone lines and voice mail.
2.14 Four (4) Telephones lines (dedicated to computer use) with high-speed Internet connection (minimum of DSL or cable modem service).

3. Field Office Computer System
The Construction Manager shall provide Insert number of computers Field office computer system for the Department's exclusive use for each field office specified. The Construction Manager has the option to provide either a desktop or a laptop computer system in accordance with the minimum requirements listed below.

3.1 Field Office Desktop Computer System:

.1 Processor:
.2 Memory:
.3 Hard Drive:
.4 Optical Drive:
.5 Ports:

.5 Network/Wireless: Ethernet or wireless card to be compatible with the selected internet and office network connections;
.6 Graphics:
.7 Monitor:
.8 Keyboard:
.9 Mouse:

3.1 Field Office Laptop Computer System:

.1 Processor:

.2	Memory:	
.3	Hard Drive:	
.4	Optical Drive:	
.5	Ports:	
.5	Network/Wireless:	Ethernet or wireless card to be compatible with the selected internet and office network connections;
.6	Graphics:	
.7	Display:	
.8	Battery:	
.9	External Monitor:	
.10	External Keyboard	
.11	External Mouse:	
.12	Miscellaneous:	One compatible port replicator with AC adapter, one additional AC adapter, one DC adapter and one padded carrying case

4. Computer Software:
The Construction Manager shall provide software for the computer system in accordance with the minimum requirements listed below.

4.1 Operating System Software:
4.2 Productivity Software:
4.3 Security Software:

4.4 All software shall include the most current updates and patches at the time the computer system is provided to the Owner. The Construction Manager shall provide for installation of updates and patches for the operating system, productivity and security software during the term of use of the computer system by the Owner. Updates and patches shall be provided by an automatic update method.

4.5 The Owner may install and maintain proprietary software on the computer in order to run the Owner's construction management programs.

5. Miscellaneous Computer Requirements
The initial condition of the computer system shall be nearly pristine. All owner installed e-mail accounts, games, spyware, online services, applications, network or other profiles previously set up on the system shall be removed prior to placement in the field office. If the system was provided for a previous Department of Construction Services contract, all software not specified shall be removed prior to placement in the current field office.

5.1 The shall provide an uninterruptible power supply (UPS), minimum _____ VA, _____ Watts and full time surge suppression for each field office computer system specified in this Section.

5.2 The Construction Manager shall provide all cables, connections and software required to connect the field office computer system to the printer and the scanner.

5.3 When more than one computer system is specified for a field office, the Construction Manager shall provide either an Ethernet or wireless office network to allow all computer systems in the field office to access the field office internet service, the printer and the scanner.

5.4 The Construction Manager shall provide appropriate dust covers for all field office desktop computer systems.

5.5 The Construction Manager shall provide all manuals necessary for operation of the computer system and software with the system and shall include all documentation normally furnished with the equipment and software when purchased.

5.6 The Owner will be utilizing the computer system to run or access Owner provided construction management software applications. These

applications are known to run on Intel and AMD compatible equipment when using the Windows _____ operating system. If the Owner experiences problems running these applications due to hardware or software compatibility, the Construction Manager shall replace the equipment to ensure compatibility to the satisfaction of the Owner within five (5) business days.

5.7 The computer system shall be maintained in good working order. If a portion of the system becomes defective, inoperable, damaged, or stolen, that portion shall be repaired or replaced within five (5) business days after the Construction Manager is notified by the Owner. If the computer system and related accessories are not maintained by the Design-Builder as required, the Owner may withhold partial payments until the computer system is operational to the Owner's satisfaction.

6. Field Office Internet Service:
The Construction Manager shall provide broadband internet service for the field office. Broadband internet service shall be capable of a minimum average upload speed of unless otherwise approved by the Owner.

7. When the Construction Manager supplies the trailer(s) they shall equip each trailer with a water cooler for hot and cold water.

C. Storage and Fabrication Sheds: Install storage and fabrication sheds sized, furnished, and equipped to accommodate materials and equipment involved, including temporary utility service. Sheds may be open shelters or fully enclosed spaces within the building or elsewhere on-site.

1. Storage sheds for tools, materials and equipment shall be weathertight with heat, lighting and ventilation for products requiring controlled conditions.

2. Remove temporary materials, equipment services and construction before Substantial Completion.

3. Clean and repair damage caused by installation or use of temporary facilities. Restore existing facilities used during construction to specified or original condition.

D. Storage and Fabrication Sheds: Install storage and fabrication sheds sized, furnished, and equipped to accommodate materials and equipment involved, including temporary utility service. Sheds may be open shelters or fully enclosed spaces within the building or elsewhere on-site.

4. Storage sheds for tools, materials and equipment shall be weathertight with heat, lighting and ventilation for products requiring controlled conditions.

5. Remove temporary materials, equipment services and construction before Substantial Completion.

6. Clean and repair damage caused by installation or use of temporary facilities. Restore existing facilities used during construction to specified or original condition.

E. Temporary Roads and Paving: Construct and maintain temporary roads and paving to support the indicated loading adequately and to withstand exposure to traffic during the construction period. Locate temporary paving for roads, storage areas, and parking where the same permanent facilities will be located. Review proposed modifications to permanent paving with the Owner's Representative, CT DCS PM and Architect.

1. Provide paving for pedestrian access and parking for field offices.

2. Paving: Comply with Division 32 Section 32 12 16 "Asphalt Paving" for construction and maintenance of temporary paving.

3. Coordinate temporary paving development with sub-grade grading, compaction, installation and stabilization of sub-base and installation of base and finish courses of permanent paving.

4. Install temporary paving to minimize the need to rework the installations and to result in permanent roads and paved areas without damage or deterioration when occupied by the Owner.

5. Extend temporary paving in and around the construction area as necessary to accommodate delivery and storage of materials, equipment usage, administration, and supervision.

F. Dewatering Facilities and Drains: For temporary drainage and dewatering facilities and operations not directly associated with construction activities included under individual Sections, comply with dewatering requirements of applicable Division 31 Sections. Where feasible, utilize the same facilities. Maintain the site, excavations, and construction free of water.

G. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities.

1. Where heat is needed and the permanent building enclosure is not complete, provide temporary enclosures where there is no other provision for containment of heat. Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.

2. Install tarpaulins securely, with incombustible wood framing and other materials. Close openings of 25-sq ft or less with plywood or similar materials.

3. Close openings through floor or roof decks and horizontal surfaces with load-bearing, wood-framed construction.

4. Where temporary enclosure exceeds 100-sq ft in area, use UL-labeled, fire-retardant-treated material for framing and main sheathing.

H. Temporary Lifts, Hoists and Elevator Use:

1. Provide facilities for hoisting materials and employees. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

2. Refer to Division 14 Sections for elevators.

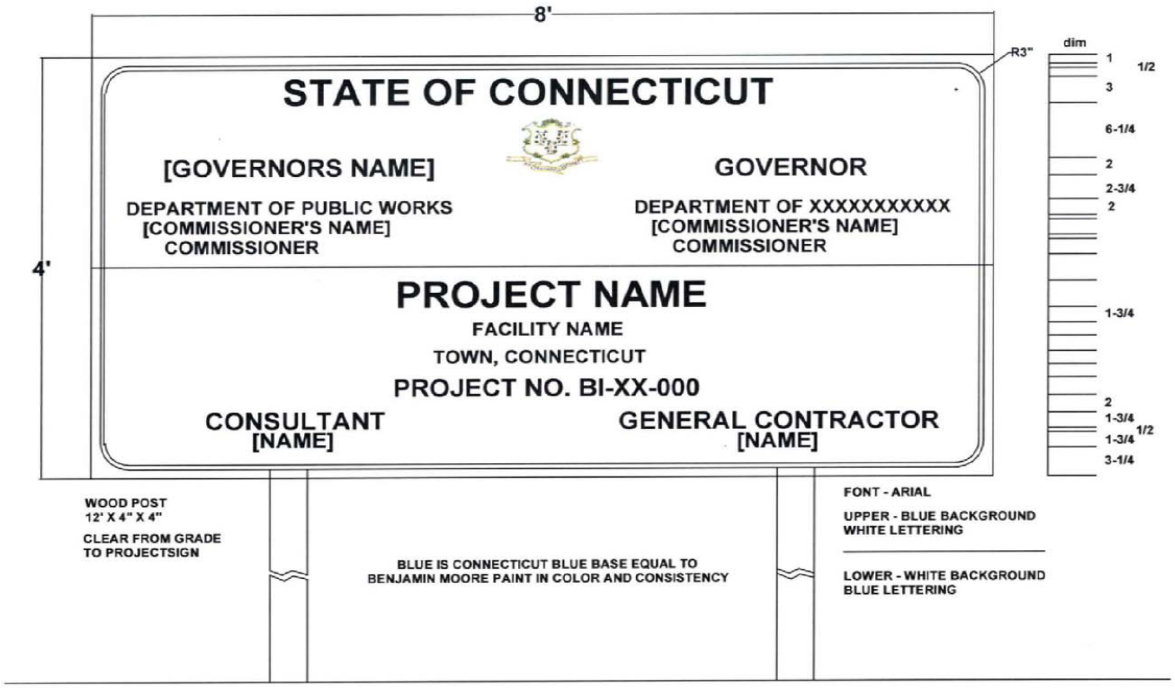
I. Temporary Project Identification Signs: Prepare project identification and other signs of size indicated. Install signs where indicated to inform the public and persons seeking entrance to the Project. Support on posts or framing of preservative-treated wood or steel. Do not permit installation of unauthorized signs.

J. Project Sign: Engage an experienced sign painter to apply graphics. Comply with details to be furnished by the Owner's Representative.

a. Temporary Tripod Frame: For groundbreaking ceremonies only, provide a temporary tripod for the sign illustrated and described below. Make the tripod of 12 ft long 2" x 4"s (Stud Grade), beveled and bolted at the top. Provide approximately 5-ft between legs at grade. Provide a 6-ft long, 2" x 4" seat for the sign; locate 5-ft above grade and nail in place. Nail sign at four (4) places where edges intersect tripod legs. Drive a 24" long, pointed 2" x 4" stake into the earth next to each leg and nail to legs.

b. Project Sign: The Construction Manager shall contact the Owner's Representative for the proper wording for the project sign. Fabricate sign of 3/4" Exterior Grade A-B Fir plywood. Mount sign on preservative treated Fir posts. The Owner shall provide design, color selection and illustration of the Project Sign. Paint both sides and all edges of sign and the posts with two (2) coats of exterior, white, alkyd primer. Paint the border and letters with "bulletin" (sign) paint. Letter sizes, colors and related information are given on the illustration below. A self-adhesive decal of the State seal will be furnished at the Contract signing. Erect the sign within two (2) weeks after execution of the Contract and remove the sign within one (1) week after completion of the project.

c. Project Sign detail:



K. Temporary Exterior Lighting: Install exterior yard and sign lights so signs are visible when Work is being performed.

L. Collection and Disposal of Waste and Cleaning:

1. Collect waste within the contract limit line from construction areas daily. Provide separate containers for proper waste recycling. Comply with requirements of NFPA 241 for removal of combustible waste material and debris. Enforce requirements strictly. Do not hold materials more than seven (7) days during normal weather or three (3) days when the temperature is expected to rise above 80º degrees F. Handle hazardous, dangerous, or unsanitary waste materials separately from other waste by containerizing properly. Dispose of material lawfully.

2. Maintain areas under Construction Manager's control free of waste materials, debris and rubbish. Maintain in a clean and orderly condition.

3. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces and other closed or remote spaces before closing the space.

4. Periodically clean interior areas before start of surface finishing and continue cleaning on an as-needed basis.

5. Control cleaning operations so that dust and other particulates will not adhere to wet or newly coated surfaces.

M. Temporary Environmental Controls: Construction Manager is to provide the following controls.

1. Rodent and Pest Control: Before deep foundation work has been completed, retain a local exterminator or pest control company to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests. Employ this service to perform extermination and control procedures at regular intervals so the Project will be free of pests and their residues at materials.

2. Dust Control (construction and demolition).

3. Noise Control.

4. Erosion and Sediment Control.

5. Pollution Control.

6. Traffic Control.

N. Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate. Cover finished permanent stairs with a protective covering of plywood or similar material so finishes will be undamaged at the time of acceptance.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Except for use of permanent fire protection as soon as available, do not change over from use of temporary security and protection facilities to permanent facilities until Substantial Completion, or longer, as requested by the Owner.

B. Temporary Fire Protection: Until fire-protection needs are supplied by permanent facilities, install and maintain temporary fire-protection facilities of the types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 10 "Standard for Portable Fire Extinguishers" and NFPA 241 "Standard for Safeguarding Construction, Alterations, and Demolition Operations."

1. Provide and locate fire extinguishers where convenient and effective for their intended purpose, but not less than one extinguisher on each floor at or near each usable stairwell.

2. Store combustible materials in containers in fire-safe locations.

3. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire-protection facilities, stairways, and other access routes for fighting fires. Prohibit smoking in hazardous fire-exposure areas.

4. Provide supervision of welding operations, combustion-type temporary heating units, and similar sources of fire ignition.

5. The Construction Manager, during construction, shall be responsible for loss or damage by fire to the work of the Contract until completion. Any fire used within the structure for working purposes shall be extinguished when not in use. Bitumen or tar shall be melted on the ground only. No flammable material shall be stored in the structure in excess of amounts allowed by the authorities. No gasoline shall be stored in or close to the building at any time. The Construction Manager shall assign a responsible employee to be in charge of fire protection measures.

6. If an EPDM or other single-ply roof is included in the work that requires cleaning of mating surfaces of laps with gasoline, limit amount of gasoline on roof to two (2) gallons which shall be in UL listed containers. Also provide one 30 B:C fire extinguisher within 75 feet of any point on the roof.

C. Permanent Fire Protection: At the earliest feasible date in each area of the Project, complete installation of the permanent fire-protection facility, including connected services, and place into operation and use. Instruct key personnel on use of facilities.

D. Security for Site and Agency:

1. Provide security program and facilities to protect work, existing facilities and the Owner and Agency's operations from unauthorized entry, vandalism and theft. Coordinate with the Owner's and Agency's security program.

2. The Construction Manager shall be solely responsible for damage, loss or liability due to theft or vandalism.

E. Barricades, Warning Signs, and Lights: Comply with standards and code requirements for erection of structurally adequate barricades. Paint with appropriate colors, graphics, and warning signs to inform personnel and the public of the hazard being protected against. Where appropriate and needed, provide lighting, including flashing red or amber lights.

1. Provide covered walkways as required by governing authorities for public rights-of-way and for public access to existing buildings.

2. Provide temporary, insulated, weathertight closures at openings to the exterior to provide acceptable working conditions and protection for materials, to allow for temporary heating and to prevent entry of unauthorized persons. Provide doors with self-closing hardware and locks.

3. Barriers and enclosures shall be in conformance with code requirements. Do not block egress from occupied buildings unless necessary to further the work of the Contract. In this case, secure the Owners approval of an alternate egress plan.

4. See also General Conditions Article 19, "Protection of the Work, Persons and Property".

F. Enclosure Fences: Before excavation begins, install an enclosure fence with lockable entrance gates. Locate where indicated on the Construction Documents, or enclose the entire site or the portion determined sufficient to accommodate construction operations. Install in a manner that will prevent people, dogs, and other animals from easily entering the site, except by the entrance gates.

1. Provide chain link construction fencing with posts set in a compacted mixture of gravel and earth. Use existing fence to the extent possible.

G. Security Enclosure and Lockup: Install substantial temporary enclosure of partially completed areas of construction. Provide locking entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Provide keys to the Owner's Representative.

1. Storage: Where materials and equipment must be stored, and are of value or attractive for theft, provide a secure lockup. Enforce discipline in connection with the installation and release of material to minimize the opportunity for theft and vandalism.

H. Protection:

1. Protect buildings, equipment, furnishings, grounds and plantings from damage. Any damage shall be repaired or otherwise made good at no expense to the Owner.

2. Provide protective coverings and barricades to prevent damage. The Construction Manager shall be held responsible for, and must make good at his own expense, any water or other type of damage due to improper coverings. Protect the public and building personnel from injury.

3. Provide temporary protection for installed products. Control traffic in immediate area to minimize damage.

4. Provide protective coverings for walls, projections, jambs, sills and soffits of openings. Protect finished floors and stairs from traffic, movement of heavy objects and storage. Prohibit traffic and storage on waterproofed and roofed surfaces and on lawn and landscaped areas.

5. Provide temporary partitions and ceilings to separate work areas from Agency-occupied areas to prevent penetration of dust and moisture into Agency-occupied areas and equipment. Erect framing and sheet materials with closed joints and sealed edges at intersections with existing surfaces.

6. See also General Conditions Article 19, "Protection of the Work, Persons and Property".

I. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations, and minimize the possibility that air, waterways, and subsoil might be contaminated or polluted or that other undesirable effects might result.

J. Traffic Ways:

1. The Construction Manager may use on-site paved roads and parking areas but shall not encumber same or their access. Public highways shall not be blocked by standing trucks, parked cars, material storage, construction operations or in any other manner.

2. Public roads and existing paved roads, drives and parking areas on Owner's property shall be kept free from scrap or debris due to construction operations and any damage to their surface caused by the Construction Manager shall be repaired by him at his own expense.

3. If the work of the Contract affects public use of any street, road, highway or thoroughfare, the Construction Manager shall confer with the police authority having jurisdiction to determine if and how many police are needed for public safety in addition to any barriers and signals that may be needed. The Construction Manager will be responsible for payment of any needed police services.

4. Access to [Insert] located [Insert] will not be used during time periods when the school children are arriving and being dismissed. No access to the Gate will be allowed:

Monday – Friday	7:30	a.m.	to	9:00	a.m.
Monday – Friday	2:30	p.m.	to	3:30	a.m.

This time period is subject to change at the discretion of the Owner's Representative to coincide with the [Insert] Schedule.

K. Identification Badges for Construction Manager's Personnel, Visitors & Parking Stickers:

1. The Construction Manager will provide each person working or visiting at the site with an identification badge, bearing the name of the Construction Manager and a number. As badges are assigned, a record shall be kept by the Construction Manager and given to the Owner's Representative and Agency Representative. Update and correct the records of all badges issued on a semi-monthly basis.

2. Badges are to be worn on outer garment where visible at all times while at the construction site, return them to the Construction Manager's field office at the end of each day and pick them up there each morning.

3. All vehicles parking in the Construction Manager's parking lot and those used around the site require an ID sticker. They will be issued by the Agency. Each Construction Manager shall apply for parking stickers through the Owner's Representative no more than semi-monthly and shall keep record of all stickers issued.

3.5 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. Limit availability of temporary facilities to essential and intended uses to minimize waste and abuse.

B. Maintenance: Maintain facilities in good operating condition until removal. Protect from damage by freezing temperatures and similar elements.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a twenty-four (24) hour basis where required to achieve indicated results and to avoid possibility of damage.

2. Protection: Prevent water-filled piping from freezing. Maintain markers for underground lines. Protect from damage during excavation operations.

C. Termination and Removal: Unless the Architect/OR requests that it be maintained longer, remove each temporary facility when the need has ended, when replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with the temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are the Construction Manager's property. The Owner reserves the right to take possession of project identification signs.

2. Remove temporary paving not intended for or acceptable for integration into permanent paving. Where the area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil in the area. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at the temporary entrances, as required by the governing authority.

3. At Substantial Completion, clean and renovate permanent facilities used during the construction period including, but not limited to, the following:

a. Replace air filters and clean inside of ductwork and housings.

b. Replace significantly worn parts and parts subject to unusual operating conditions.

c. Replace lamps burned out or noticeably dimmed by hours of use.

END OF SECTION 01 50 00 - CMR

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. General protection and pruning of existing trees and plants that are affected by execution of the Work, whether temporary or permanent construction.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIRMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 31 10 00 "Site Clearing" for removing existing trees and shrubs.

1.3 DEFINITIONS

A. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Existing Conditions: Documentation of existing trees and plantings indicated to remain, which establishes preconstruction conditions that might be misconstrued as damage caused by construction activities.

1.5 QUALITY ASSURANCE

A. Arborist Qualifications: Certified Arborist as certified by ISA, Licensed arborist in jurisdiction where Project is located, current member of ASCA, or Registered Consulting Arborist as designated by ASCA .

B. Preinstallation Conference: Conduct conference at Project site.

1.6 PROJECT CONDITIONS

A. The following practices are prohibited within protection zones:

1. Storage of construction materials, debris, or excavated material.
2. Parking vehicles or equipment.
3. Foot traffic.
4. Erection of sheds or structures.
5. Impoundment of water.
6. Excavation or other digging unless otherwise indicated.
7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

B. Do not direct vehicle or equipment exhaust toward protection zones.

C. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones and organic mulch.

PART 2 - PRODUCTS

A. Organic Mulch: Free from deleterious materials and suitable as a top dressing for trees and shrubs, consisting of one of the following:

1. Type: Wood and bark chips.
2. Size Range: 3 inches maximum, 1/2 inch minimum.

B. Protection-Zone Fencing: Fencing fixed in position and meeting the following requirements.

1. Chain-Link Protection-Zone Fencing: Galvanized-steel fencing fabricated from minimum 2-inch opening, 0.148-inch- diameter wire chain-link fabric; with pipe posts, minimum 2-3/8-inch- OD line posts, and 2-7/8-inch- OD corner and pull posts; with 1-5/8-inch- OD top rails ; with 0.177-inch- diameter top tension wire and 0.177-inch- diameter bottom tension wire; with tie wires, hog ring ties, and other accessories for a complete fence system.

a. Height: 6 feet.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Erosion and Sedimentation Control: Examine the site to verify that temporary erosion- and sedimentation-control measures are in place. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

3.2 PREPARATION

A. Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.

B. Tree-Protection Zones: Mulch areas inside tree-protection zones and other areas indicated.

1. Apply 6-inch average thickness of organic mulch. Do not place mulch within 6 inches of tree trunks.

3.3 TREE- AND PLANT-PROTECTION ZONES

A. Protection-Zone Fencing: Install protection-zone fencing along edges of protection zones before materials or equipment are brought on the site and construction operations begin in a manner that will prevent people and animals from easily entering protected area except by entrance gates. Construct fencing so as not to obstruct safe passage or visibility at vehicle intersections where fencing is located adjacent to pedestrian walkways or in close proximity to street intersections, drives, or other vehicular circulation.

1. Chain-Link Fencing: Install to comply with ASTM F 567 and with manufacturer's written instructions.

2. Posts: Set or drive posts into ground one-third the total height of the fence without concrete footings. Where a post is located on existing paving or concrete to remain, provide appropriate means of post support acceptable to Architect.

B. Maintain protection zones free of weeds and trash.

C. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Architect.

D. Maintain protection-zone fencing in good condition as acceptable to Architect and remove when construction operations are complete and equipment has been removed from the site.

3.4 ROOT PRUNING

A. Prune roots that are affected by temporary and permanent construction. Prune roots as follows:

1. Cut roots manually by digging a trench and cutting exposed roots with sharp pruning instruments; do not break, tear, chop, or slant the cuts. Do not use a backhoe or other equipment that rips, tears, or pulls roots.
2. Temporarily support and protect roots from damage until they are permanently redirected and covered with soil.
3. Cover exposed roots with burlap and water regularly.
4. Backfill as soon as possible.

B. Root Pruning at Edge of Protection Zone: Prune roots flush with the edge of the protection zone, by cleanly cutting all roots to the depth of the required excavation.

C. Root Pruning within Protection Zone: Clear and excavate by hand to the depth of the required excavation to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.

3.5 CROWN PRUNING

A. Prune branches that are affected by temporary and permanent construction. Prune branches as follows:

1. Pruning Standards: Prune trees according to ANSI A300 (Part 1).
2. Cut branches with sharp pruning instruments; do not break or chop.
3. Do not apply pruning paint to wounds.

B. Chip removed branches and dispose of off-site.

3.6 REGRADING

A. Lowering Grade: Where new finish grade is indicated below existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.

B. Minor Fill within Protection Zone: Where existing grade is 2 inches or less below elevation of finish grade, fill with topsoil. Place topsoil in a single uncompacted layer and hand grade to required finish elevations.

3.7 REPAIR AND REPLACEMENT

A. General: Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Architect.

1. Have arborist perform the root cutting, branch pruning, and damage repair of trees and shrubs.
2. Treat damaged trunks, limbs, and roots according to arborist's written instructions.
3. Perform repairs within 24 hours.
4. Replace vegetation that cannot be repaired and restored to full-growth status, as determined by Architect.

3.8 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove excess excavated material, displaced trees, trash and debris, and legally dispose of them off Owner's property.

END OF SECTION 01 56 39

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Construction Documents and general provisions of the CMR Agreement Between Owner and Construction Manager and the Guaranteed Maximum Price (GMP) Amendment, including Division 00 General Conditions of the Contract for Construction – CMR and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Microbial and fungal contamination control.
   2. Indoor air quality and pollution control.
   3. Heating, ventilating, and air conditioning.

B. Related Sections: The following Sections contain requirements that relate to this Section:
   1. Division 01 Section 01 45 23.13 "Testing for IAQ, Baseline IAQ & Materials - CMR" for building flush out requirements.
   2. Division 01 Section 01 57 40 "Construction IAQ Management Plan - CMR" for a description of the IAQ management plan.

1.3 REFERENCES

1. ASTM International (ASTM):
   a. ASTM D5116-2006, Standard Guide for Small-Scale Environmental Chamber Determination of Organic Emissions From Indoor Materials/Products.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 MICROBIAL AND FUNGAL CONTAMINATION CONTROL

A. Perform, schedule, and sequence Work as required to limit conditions supporting formations of microbes, molds, and fungi.
   1. Control water penetration, dampness, and humidity to prevent products not treated for exterior use from becoming soaked or damp.
   2. Enclose building prior to installing interior materials and finishes.
   3. Do not install interior products subject to moisture absorption until building is enclosed and wet work generating moisture and humidity is complete.

B. When visible formations are observed and when formations cannot be completely removed by non-abrasive surface cleaning:
   1. Remove and replace materials identified as food sources for microbes, molds, and fungi.
   2. Correct conditions supporting microbial, mold, and fungal growth.

C. Remove interior products and finishes, identified as food sources that have absorbed sufficient moisture to become damp whether or not microbial, mold, or fungal growth is observed. Include:
   1. Gypsum board cores.

2. Organic materials composed of cellulose fiber or paper.
3. Materials containing sucrose or other binders identified as supporting microbial growth.

D. Remove fibrous insulation materials subject to retaining moisture such as duct liner, insulation, and other materials that are made wet or damp and cannot immediately be made dry.

E. Repair or replace ductwork, pans, and other conditions subject to moisture condensation, water penetration, or other water source not drained and made dry.
1. Remove conditions that have become an environment for microbes, molds, or fungi.
2. Do not permit conditions leading to standing water.

F. Install wet work and allow time needed to dry and cure prior to installing materials such as carpet, acoustical material, textiles, and other material of type that may attract and retain moisture.

3.2 INDOOR AIR QUALITY AND POLLUTION CONTROL

A. Product Emission Rate Standards: Test to ASTM D5116 for maximum indoor air concentration levels.
1. Formaldehyde:
a. 0.03 parts per million where no other requirements are specified.
b. 0.005 parts per million where products are specified as formaldehyde free.
2. Total VOC Emissions for Carpet Tile, Adhesives, and Sealers: 0.05 mg/m^2 per hour.
3. 4 Phenyl Cyclohexene (4-PC) Particulate Emissions for Carpet: One (1) part per billion.
4. Total Particulate Emission Rate Levels: 50 ug/m^3.
5. Primary and Secondary Regulated Pollutants: Conform to USEPA, Code of Federal Regulations, Title 40, Part 50 National Air Ambient Air Quality Standard. Refer to EPA Web Site http://www.epa.gov/epahome/rules.html#codified.
6. Other Pollutants Not Listed: Not greater than 1/10 of Threshold Limit Value - Time Weighted Average (TLV-TWA) industrial workplace standard.

B. Architectural Coatings - Volatile Organic Compound (VOC) Content Limits: Conform to US Environmental Protection Agency (EPA) Federal Register 48886/Vol. 63, No.176 Friday, September 11, 1998/ Rules and Regulations. Refer to EPA Web Site: http://www.epa.gov/ttn/atw/eparules.html.

C. Do not use products in combination with or in contact with other products that can be identified as combining to form toxic fumes or sustained odors.

D. Do not use solvents within interior areas that may penetrate and be retained in absorptive materials such as concrete, gypsum board, wood, cellulose products, fibrous material, and textiles.

E. Protect construction materials from contamination and pollution from contact with construction dust, debris, fumes, solvents, and other environmentally polluting materials.

F. Allow furnishings and materials such as carpet, floor tile, acoustical tile, textiles, office furniture, and casework, to air out in clean environment prior to installation.

3.3 HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

A. Do not run permanent HVAC system during course of construction. Seal ductwork intake and exhaust vents.

B. Heat, dehumidify, and ventilate building during course of Work as necessary to maintain environmental conditions suitable for drying and curing materials and for prevention of conditions suitable for mold and mildew growth.

1. Ventilate building to remove moisture, dust, fumes, and odors.
2. Temper and dehumidify air as needed to remove excess moisture.
3. Do not use propane heaters and other moisture generating heating systems.

C. Flush out building prior to commissioning. Refer to Section 01 45 23.13 "Testing for IAQ, Baseline IAQ & Materials - CMR" for procedure.

D. Inspect ductwork for refuse, contaminants, moisture and other foreign contamination prior to commissioning. Notify Commissioning Authority (CA) of satisfactory inspection prior to beginning of Commissioning.

E. Clean underfloor plenum at access flooring acting as supply air duct, prior to occupancy.

3.4 REMEDIAL ACTION

A. Promptly take action as necessary to inspect and remediate conditions suspected of supporting microbial, fungal or mold conditions and where contaminated by indoor air pollution.

B. Notify and consult with Architect prior to beginning remedial action where contamination by hazardous chemicals, microbes, and fungi is suspected.

END OF SECTION 01 57 30 - CMR

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Construction Documents and general provisions of the CMR Agreement Between Owner and Construction Manager and the Guaranteed Maximum Price (GMP) Amendment, including Division 00 General Conditions of the Contract for Construction – CMR and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes:
   1. Description of a Construction Indoor Air Quality (IAQ) Management Plan.
   2. IAQ construction requirements.

B. Related Sections: The following Sections contain requirements that relate to this Section:
   1. Divisions 01 through 49 sections for green building rating system requirements specific to the Work of each of those sections. These requirements may or may not include reference to LEED or Green Globes.
   2. Division 01 Section 01 45 23.13 "Testing for IAQ, Baseline IAQ, & Materials - CMR."
   3. Division 01 Section 01 57 30 "Indoor Environmental Control - CMR."
   4. Division 01 Section 23 05 93 "Testing, Adjusting and Balancing for HVAC - CMR" for additional requirements for baseline testing for IAQ. – CMR.
   5. Division 01 Section 23 05 93 "Testing, Adjusting and Balancing for HVAC - CMR" for cleaning of HVAC system including ductwork, air intakes and returns, and changing of filters.

1.3 REFERENCES

A. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE):
   1. ASHRAE Standard 52.1-1992, Gravimetric and Dust Spot Procedures for Testing Air Cleaning Devices in General Ventilation for Removing Particulate Matter.

B. ASTM International, Inc. (ASTM):
   1. ASTM D5116-2006, Standard Guide for Small-Scale Environmental Chamber Determinations of Organic Emissions From Indoor Materials/Products.

C. Sheet Metal and Air Conditioning National Contractors' National Association (SMACNA):
   1. IAQ Guidelines for Occupied Buildings under Construction, 1995.

1.4 INDOOR AIR QUALITY

A. Goals: The Owner has set the following indoor air quality goals for jobsite operations on the project, within the limits of the construction schedule, Guaranteed Maximum Price, and available materials, equipment, products and services. Goals include:
   1. Protect workers on the site from undue health risks during construction.
   2. Prevent residual problems with indoor air quality in the completed building.

1.5 SUBMITTALS

A. Indoor Air Quality Plan: Within fourteen (14) days after receipt of [Notice of Award] [Insert] and prior to any waste removal from the project, develop and submit for review a healthy indoor air quality plan. The plan shall include:
   1. List of IAQ protective measures to be instituted on the site.
   2. Schedule for inspection and maintenance of IAQ measures.

1.6 QUALITY ASSURANCE

A. Perform material tests and report results in accordance with ASTM D5116.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. Should the Construction Manager desire to use procedures, materials, equipment, or products that are not specified but meet the intent of the specifications to protect indoor air quality on the site, the Construction Manager shall propose these substitutions in accordance with Section 01 60 00 "Product Requirements - CMR."

2.2 MATERIALS

A. Low emitting products have been specified in appropriate sections.

PART 3 - EXECUTION

3.1 CONSTRUCTION IAQ MANAGEMENT PLAN

A. Meet or exceed the minimum requirements of the SMACNA "IAQ Guidelines for Occupied Buildings Under Construction."

1. Protect the ventilation system components from contamination, or provide cleaning of the ventilation components exposed to contamination during construction prior to occupancy.
2. After construction ends, prior to occupancy and with all interior finishes installed, perform a building flush-out by supplying a total air volume of 14000 cu ft of outdoor air per sq ft of floor area while maintaining an internal temperature of at least 60 degrees F and relative humidity no higher than 60 percent.
   a. [Insert reference to specification section where building air flush-out is specified in detail or insert requirements here.]
3. If building occupancy is to occur before completion of the flush-out, deliver a minimum of 3500 cu ft of outdoor air per sq ft of floor area to the space. Once the space is occupied, ventilate it at a minimum rate of 0.30 cfm/sq ft of outside air or the design minimum outside air rate determined in accordance with Sections 4 through 7 of ASHRAE 62.1 or applicable local code, whichever is more stringent. During each day of the flush-out period, begin ventilation a minimum of three (3) hours prior to occupancy and continue during occupancy. Maintain these conditions until a total of 14000 cu ft/sq ft of outside air has been delivered to the space.

B. During installation of carpet, paints, furnishings, and other VOC-emitting products, provide supplemental (spot) ventilation for at least 72 hours after work is completed. Preferred HVAC system operation uses supply air fans and ducts only; exhaust provided through windows. Use exhaust fans to pull exhaust air from deep interior locations. Stair towers and other paths to exterior can be useful during this process.

C. Conduct regular inspection and maintenance of indoor air quality measures including ventilation system protection, and ventilation rate.

D. Require VOC-safe masks for workers installing VOC-emitting products (interior and exterior) defined as products that emit 150 gpl or more UNLESS local jurisdiction's requirements are stricter, in which case the strictest requirements shall be followed for use of VOC-safe masks.

E. Use low-toxic cleaning supplies for surfaces, equipment, and worker's personal use. Options include several soybean-based solvents and cleaning options (SoySolv) and citrus-based cleaners.

F. Use wet sanding for gypsum board assemblies. Exception: Dry sanding allowed subject to Architect's approval of the following measures:
   1. Full isolation of space undergoing finishing.
   2. Plastic protection sheeting is installed to provide air sealing during sanding.
   3. Closure of all air system devices and ductwork.
   4. Sequencing of construction precludes the possibility of contamination of other spaces with gypsum dust.
   5. Worker protection is provided.

G. Use safety meetings, signage, and Construction Manager agreements to communicate the goals of the construction indoor air quality plan.

END OF SECTION 01 57 40 - CMR

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Construction Documents and general provisions of the CMR Agreement Between Owner and Construction Manager and the Guaranteed Maximum Price (GMP) Amendment, including Division 00 General Conditions of the Contract for Construction – CMR and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements governing the-Construction Manager's selection of products for use in the Project.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 01 Section 01 25 00 "Substitution Procedures - CMR" specifies administrative procedures for handling requests for substitutions made after award of the Contract.

2. Division 01 Section 01 33 00 "Submittal Procedures - CMR" specifies requirements for submittal of the Construction Manager's Construction Schedule or CPM Schedule and the Submittal Schedule.

3. Division 01 Section 01 42 20 "Reference Standards and Definitions - CMR" specifies the applicability of industry standards to products specified.

1.3 DEFINITIONS

A. Definitions used in this Article are not intended to change the meaning of other terms used in the Contract Documents, such as "specialties," "systems," "structure," "finishes," "accessories," and similar terms. Such terms are self-explanatory and have well-recognized meanings in the construction industry.

1. "Products" are items purchased for incorporation in the Work, whether purchased for the Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

a. "Named Products" are items identified by the manufacturer's product name, including make or model number or other designation, shown or listed in the manufacturer's published product literature, which is current as of the date of the Contract Documents.

2. "Materials" are products substantially shaped, cut, worked, mixed, finished, refined or otherwise fabricated, processed, or installed to form a part of the Work.

3. "Equipment" is a product with operational parts, whether motorized or manually operated, that requires service connections, such as wiring or piping.

1.4 QUALITY ASSURANCE

A. Source Limitations: To the fullest extent possible, provide products of the same kind from a single source.

B. Compatibility of Options: When the Construction Manager is given the option of selecting between two (2) or more products for use on the Project, the product selected shall be compatible with products previously selected, even if previously selected products were also options.

C. Nameplates: Except for required labels and operating data, do not attach or imprint manufacturer's or producer's nameplates or trademarks on exposed surfaces of products that will be exposed to view in occupied spaces or on the exterior.

1. Labels: Locate required product labels and stamps on concealed surfaces or, where required for observation after installation, on accessible surfaces that are not conspicuous.

2. Equipment Nameplates: Provide a permanent nameplate on each item of service-connected or power-operated equipment. Locate on an easily accessible surface that is inconspicuous in occupied spaces. The nameplate shall contain the following information and other essential operating data:

a. Name of product and manufacturer.

b. Model and serial number.

c. Capacity.

d. Speed.

e. Ratings.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products according to the manufacturer's recommendations, using means and methods that will prevent damage, deterioration, and loss, including theft.

1. Schedule delivery to minimize long-term storage at the site and to prevent overcrowding of construction spaces.

2. Coordinate delivery with installation time to assure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.

3. Deliver products to the site in an undamaged condition in the manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing. Store products in accordance with manufacturers' instructions and maintain within temperature and humidity range required by manufacturer.

4. Inspect products upon delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.

5. Store products at the site in a manner that will facilitate inspection and measurement of quantity or counting of units.

6. Store heavy materials away from the Project structure in a manner that will not endanger the supporting construction.

7. Store products subject to damage by the elements above ground, under cover in a weathertight enclosure, with ventilation adequate to prevent condensation.

8. For exterior storage of fabricated products, place on sloped supports above ground. Cover products subject to deterioration with impervious sheet covering; provide ventilation to avoid condensation.

9. Store loose granular material on solid surfaces in a well-drained area; prevent mixing with foreign matter.

10. Arrange storage to provide access for inspection. Periodically inspect to insure products are undamaged and are maintained under required conditions. Keep log showing date, time and problems, if any.

11. Stone, masonry units and similar materials shall be stored on platforms or dry skids and shall be adequately covered and protected against damage.

12. Materials and equipment shall be delivered, stored and handled to prevent intrusion of foreign matter and damage by weather or breakage. Packaged materials shall be delivered and stored in original, unbroken packages.

13. Promptly inspect shipments to assure that products comply with requirements, that quantities are correct and products are undamaged.

14. Packages, materials and equipment showing evidence of damage will be rejected and replaced at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION

A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, new at the time of installation.

1. Provide products complete with accessories, trim, finish, safety guards, and other devices and details needed for a complete installation and the intended use and effect.

2. Standard Products: Where available, provide standard products of types that have been produced and used successfully in similar situations on other projects.

B. Product Selection Procedures: The Contract Documents and governing regulations govern product selection. Procedures governing product selection include the following:

1. Semi-proprietary Specification Requirements: Where Specifications name two (2) or more products or manufacturers, provide one (1) of the products indicated. Comply with the requirements of Division 01 Section 01 25 00 "Substitution Procedures - CMR."

2. Descriptive Specification Requirements: Where Specifications describe a product or assembly, listing exact characteristics required, with or without use of a brand or trade name, provide a product or assembly that provides the characteristics and otherwise complies with Contract requirements.

3. Compliance with Standards, Codes, and Regulations: Where Specifications only require compliance with an imposed code, standard, or regulation, select a product that complies with the standards, codes, or regulations specified.

4. Visual Selection: Where specified product requirements include the phrase *"...as selected from manufacturer's standard colors, patterns, textures..."* or a similar phrase, select a product and manufacturer that complies with other specified requirements. The Architect will select the color, pattern, and texture from the product line selected.

PART 3 - EXECUTION

3.1 INSTALLATION OF PRODUCTS

A. Comply with manufacturer's instructions and recommendations for installation of products in the applications indicated. Anchor each product securely in place, accurately located and aligned with other Work.

1. Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

END OF SECTION 01 60 00 - CMR

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Construction Documents and general provisions of the CMR Agreement Between Owner and Construction Manager and the Guaranteed Maximum Price (GMP) Amendment, including Division 00 General Conditions of the Contract for Construction – CMR and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. General: This Section specifies administrative and procedural requirements for field engineering services including, but not limited to, the following:

1. Land survey work.
2. Civil Engineering services.
3. Damage surveys.
4. Geo-technical monitoring.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 01 Section 01 31 00 "Project Management and Coordination - CMR" for procedures for coordinating field engineering with other construction activities.

2. Division 01 Section 01 33 00 "Submittal Procedures - CMR" for submitting Project record surveys.

3. Division 01 Section 01 77 00 "Closeout Procedures - CMR" for submitting final property survey with Project Record Documents and recording of Owner-accepted deviations from indicated lines and levels.

1.3 SUBMITTALS

A. Certificates: Submit a certificate from the Land Surveyor stating that the control information furnished by the Owner is accurate or identify inaccuracies, if they exist. The Construction Manager shall not take advantage of errors, which may be included in the control information. Stakes and markings shall be preserved.

B. Final Property Survey: Prepare and submit 10 copies of the final property survey.

C. Project Record Documents: Submit a record of Work performed and record survey data as required under provisions of "Submittals" and "Project Closeout" Sections.

1.4 QUALITY ASSURANCE

A. Provide field engineering services to establish and record grades, lines and elevations.

B. The Construction Manager shall retain a Land Surveyor registered by the State of Connecticut to confirm State furnished base lines and benchmarks, lay out the building, underground utility lines and other site work from the information furnished by the Owner and to establish and record the necessary elevations, at no additional cost to the State.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Identification: The Architect will identify two (2) base lines on the Contract Drawings.

B. Verify layout information shown on the Drawings, in relation to the property survey and existing benchmarks. Notify the Owner's Representative and Architect of any discrepancies immediately in writing before proceeding to lay out the Work. Locate and protect existing benchmarks and base line. Preserve permanent reference points during construction.

1. Do not change or relocate benchmarks or base line without prior written approval. Promptly report lost or destroyed reference points or requirements to relocate reference points because of necessary changes in grades or locations.

2. Promptly replace lost or destroyed Project baseline benchmarks. Base replacements on the original survey control points.

C. Establish and maintain a sufficient quantity of (minimum of 2) permanent benchmarks on the site, referenced to data established by Owner supplied information.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.

D. Existing Utilities and Equipment: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction.

1. Prior to construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping. Notify the Owner's Representative of any discrepancies prior to proceeding.

3.2 PERFORMANCE

A. Work from lines and levels established by the property survey. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of the Project. Calculate and measure required dimensions within indicated or recognized tolerances. Do not scale Drawings to determine dimensions.

1. Advise entities engaged in construction activities of benchmarks and control points for their use.

2. As construction proceeds, check every major element for line, level, and plumb.

B. Surveyor's Log: Maintain a surveyor's log of control and other survey work. Make this log available for reference.

1. Record deviations from required lines and levels, and advise the Owner's Representative and Architect when deviations that exceed indicated or recognized tolerances are detected. On Project Record Drawings, record deviations that are accepted and not corrected.

2. On completion of foundation walls, major site improvements, underground utilities, and other Work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, elevations of construction, as-built locations and site work.

C. Site Improvements: Locate and lay out site improvements, including pavements, stakes for grading, fill and topsoil placement, utility slopes, and invert elevations.

D. Building Lines and Levels: Locate and lay out batter boards for structures, building foundations, column grids and locations, floor levels, and control lines and levels required for mechanical and electrical work.

E. Existing Utilities: Furnish information necessary to adjust, move, or relocate existing structures, utility poles, lines, services, or other appurtenances located in or affected by construction. Coordinate with local authorities having jurisdiction.

F. Final Property Survey: Prepare a final property survey showing significant features (real property) for the Project. Include on the survey a certification, signed by the surveyor, that

principal metes, bounds, lines, and levels of the Project are accurately positioned as shown on the survey.

END OF SECTION 01 71 23 - CMR

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Construction Documents and general provisions of the CMR Agreement Between Owner and Construction Manager and the Guaranteed Maximum Price (GMP) Amendment, including Division 00 General Conditions of the Contract for Construction – CMR and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for cutting and patching.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 01 Section 01 31 00 "Project Management and Coordination - CMR" for procedures for coordinating cutting and patching with other construction activities.

2. Division 01 Section01 35 16 "Alteration Project Procedures - CMR" for procedures for coordinating cutting and patching with other construction activities.

3. Division 01 Section 01 15 00 “Temporary Facilities”.

4. Division 02 Section 02 41 00 "Demolition" for demolition of selected portions of the building for alterations.

5. Refer to other Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.

a. Requirements of this Section apply to mechanical and electrical installations. Refer to Division 22, 23, and 26 Sections for other requirements and limitations applicable to cutting and patching mechanical and electrical installations.

1.3 SUBMITTALS

A. Cutting and Patching Proposal: Submit a proposal to the Owner’s Representative describing procedures well in advance of the time cutting and patching will be performed to determine if the Owner and/or Architect/Engineer requires approval of these procedures before proceeding. Request approval to proceed. Include the following information, as applicable, in the proposal:

1. Describe the extent of cutting and patching required. Show how it will be performed and indicate why it cannot be avoided.

2. Describe anticipated results in terms of changes to existing construction. Include changes to structural elements and operating components as well as changes in the building's appearance and other significant visual elements.

3. Describe affects to integrity of weather exposed or moisture resistant element.

4. Describe affects to efficiency, maintenance, or safety of any operational element.

5. Describe affects to Work of Owner or separate Construction Manager.

6. List products to be used and firms or entities that will perform Work.

7. Indicate dates when cutting and patching will be performed.

8. Utilities: List utilities that cutting and patching procedures will disturb or affect. List utilities that will be relocated and those that will be temporarily out of service. Indicate how long service will be disrupted.

9. Where cutting and patching involves adding reinforcement to structural elements, submit details and engineering calculations sealed by an Engineer registered in the State of Connecticut showing integration of reinforcement with the original structure.

10. Approval by the Owner's Representative to proceed with cutting and patching does not waive the Architect/Engineer of Record's rights to later require complete removal and replacement of unsatisfactory Work.

1.4 QUALITY ASSURANCE

A. Requirements for Structural Work: Do not cut and patch structural elements in a manner that would change their load-carrying capacity or load-deflection ratio.

1. Obtain approval from the Architect/Engineer of the cutting and patching proposal before cutting and patching the following structural elements:
   a. Foundation construction.
   b. Bearing and retaining walls.
   c. Structural concrete.
   d. Structural steel.
   e. Lintels.
   f. Structural decking.
   g. Miscellaneous structural metals.
   h. Exterior curtain-wall construction.
   i. Equipment supports.
   j. Piping, ductwork, vessels, and equipment.
   k. Structural systems of special construction in Division 13 Sections.

B. Operational Limitations: Do not cut and patch operating elements or related components in a manner that would result in reducing their capacity to perform as intended. Do not cut and patch operating elements or related components in a manner that would result in increased maintenance or decreased operational life or safety.

1. Obtain Architect/Engineer's approval of the cutting and patching proposal before cutting and patching the following operating elements or safety related systems:
   a. Primary operational systems and equipment.
   b. Air or smoke barriers.
   c. Water, moisture, or vapor barriers.
   d. Membranes and flashings.
   e. Fire protection systems.
   f. Noise and vibration control elements and systems.
   g. Control systems.
   h. Communication systems.
   i. Conveying systems.
   j. Electrical wiring systems.
   k. Operating systems of special construction in Division 13 Sections.

C. Visual Requirements: Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in the Architect's opinion, reduce the building's aesthetic qualities. Do not cut and patch construction in a manner that would result in visual evidence of cutting and patching. Remove and replace construction cut and patched in a visually unsatisfactory manner.

1.5 WARRANTY

A. Existing Warranties: Replace, patch, and repair material and surfaces cut or damaged by methods and with materials in such a manner as not to void any warranties required or existing.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible if identical materials are unavailable or cannot be used. Use materials whose installed performance will equal or surpass that of existing materials.

B. The Construction Manager shall install sleeves, inserts and hangers furnished by the trades needing same.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine surfaces to be cut and patched and conditions under which cutting and patching is to be performed before cutting. If unsafe or unsatisfactory conditions are encountered, notify the Owner's Representative and Architect, before proceeding with corrective action.

B. Openings and chases may not be shown on the Drawings. It is the responsibility of the Construction Manager to examine the Architectural, Electrical, Heating, Cooling, Ventilating and Plumbing Drawings and to provide chases, channels or openings where needed.

1. After installing Work into openings, channels and/or chases, the Construction Manager shall close same. If finishes are to be restored, the new Work shall match the original and shall be done by the trade customarily responsible for the particular kind of Work.

C. The Construction Manager shall verify dimensions for built-in Work and/or Work adjoining that of other trades before ordering any material or doing any Work. Discrepancies shall be submitted to the Owner's Representative before proceeding with the Work.

D. See also Division 00 General Conditions of Contract for Construction - CMR, Article 23 "Cutting, Fitting, Patching & Digging".

3.2 PREPARATION

A. Temporary Support: Provide temporary support of Work to be cut.

B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of the Work that might be exposed during cutting and patching operations.

C. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

D. Avoid cutting existing pipe, conduit, or ductwork serving the building but scheduled to be removed or relocated until provisions have been made to bypass them.

3.3 PERFORMANCE

A. General: Employ skilled workmen to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time and complete without delay.

1. Cut existing construction to provide for installation of other components or performance of other construction activities and the subsequent fitting and patching required to restore surfaces to their original condition.
2. Do perform cutting and patching to integrate elements of Work. Provide penetrations of existing surfaces. Provide samples for testing. Seal penetrations through floors, walls, ceilings and roofs, as applicable; restore or preserve fire-rated and smoke-barrier construction. Construction and finishes shall match original Work.

B. Cutting: Cut existing construction using methods least likely to damage elements retained or adjoining construction. Where possible, review proposed procedures with the original Installer; comply with the original Installer's recommendations.

1. In general, where cutting, use hand or small power tools designed for sawing or grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces.
3. Cut through concrete and masonry using a cutting machine, such as a Carborundum saw or a diamond-core drill.
4. Comply with requirements of applicable Division 32 Sections where cutting and patching requires excavating and backfilling.
5. Where services are required to be removed, relocated, or abandoned, by-pass utility services, such as pipe or conduit, before cutting. Cut-off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal the remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after by-passing and cutting.

C. Patching: Patch with durable seams that are as invisible as possible. Comply with specified tolerances.

1. Where feasible, inspect and test patched areas to demonstrate integrity of the installation.
2. Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
3. Where removing walls or partitions extends one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform color and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
   a. Where patching occurs in a smooth painted surface, extend final paint coat over entire unbroken surface containing the patch after the area has received primer and second coat.
4. Patch, repair, or re-hang existing ceilings as necessary to provide an even-plane surface of uniform appearance.

3.4 CLEANING

A. Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar items. Thoroughly clean piping, conduit, and similar features before applying paint or other finishing materials. Restore damaged pipe covering to its original condition.

END OF SECTION 01 73 29 - CMR

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Construction Documents and general provisions of the CMR Agreement Between Owner and Construction Manager and the Guaranteed Maximum Price (GMP) Amendment, including Division 00 General Conditions of the Contract for Construction – CMR and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes requirements for waste management goals, waste management plan and waste management plan implementation.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 01 Section 01 11 00 "Summary of Work".
2. Division 01 Section 01 29 76 "Progress Payment Procedures – CMR".
3. Division 01 Section 01 25 00 "Substitution Procedures– CMR".
4. Division 01 Section 01 31 19 "Project Meetings – CMR".
5. Division 01 Section 01 33 00 "Submittal Procedures – CMR".
6. Division 01 Section 01 45 00 "Quality Control – CMR".
7. Division 01 Section 01 50 00 "Temporary Facilities and Controls – CMR".
8. Division 01 Section 01 60 00 "Product Requirements – CMR".
9. Division 01 Section 01 77 00 "Closeout Procedures – CMR".
10. Division 01 Section 01 81 13 "Sustainable Design Requirements – CMR"

1.3 DEFINITIONS

A. Construction Waste: Solid wastes such as building materials, packaging and rubble resulting from construction, paving and infrastructure.

B. Demolition Waste: Solid wastes such as concrete, wood, brick, plaster, roofing materials, wallboard, metals, carpeting, insulation, and clean fill resulting from demolition or selective demolition of structures.

C. Recyclable Materials: Products and materials that can be recovered and remanufactured into a new product. Recyclable materials include, but are not limited to, the following:

1. Metals (ferrous and non-ferrous), including banding, metal studs, ductwork, and piping.
2. Asphaltic concrete paving.
3. Portland cement concrete.
4. Gypsum products.
5. Paper and cardboard.
6. Wood products, including structural, finish, crates, and pallets.
7. Brick and masonry.
8. Carpet and padding.
9. Plastics.
10. Copper wiring.

D. Recycling Facility: A business that specializes in collecting, handling, processing, distributing, or remanufacturing waste materials generated by new construction projects, into products or materials that can be used for this project or by others.

E. Salvage and Reuse: Existing usable product or material that can be saved and reused in some manner on the project site. Materials for reuse must be approved by the Architect. Materials that can be salvaged and reused must comply with applicable technical specifications and include, but are not limited to, the following:

1. Dimensional lumber and other wood products.
2. Structural steel.
3. Soil.
4. Masonry products.
5. Plants.

F. Salvage for Resale: Existing usable product that can be saved and removed intact (as is) from the project site to another site for resale to others without remanufacturing.

1.4 WASTE MANAGEMENT GOALS

A. The Owner has established that this Project shall generate the least amount of waste possible and that processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors shall be employed.

B. The Construction Manager shall use all means available to divert the greatest extent practical and economically feasible, construction waste from landfills and incinerators.

C. Of the inevitable waste that is generated, as many of the waste materials as economically feasible shall be reused, salvaged, or recycled. Waste disposal in landfills shall be minimized.

D. Recycle and/or salvage a minimum of 95 percent of non-hazardous construction and demolition waste by weight of the total solid waste generated by the Project.

E. With regard to these goals the Construction Manager shall develop, for the Architect's review, a Waste Management Plan for this Project.

F. Take a pro-active, responsible role in management of construction waste and require all subcontractors, vendors, and suppliers to participate in the effort. Establish a construction waste management program that includes the following categories:

1. Minimizing packaging waste.
2. Salvage and reuse.
3. Salvage for resale or donation.
4. Recycling.
5. Disposal.

1.5 SUBMITTALS

A. Draft Waste Management Plan: Within thirty (30) days after receipt of Notice of Award of Bid, or prior to any waste removal, whichever occurs sooner, the Construction Manager shall submit three (3) copies of a Draft Waste Management Plan to the Owner’s Representative.

B. Final Waste Management Plan: Once the Owner has determined which of the recycling options addressed in the Draft Waste Management Plan are acceptable, the Construction Manager shall submit within ten (10) days three (3) copies of a Final Waste Management Plan.

C. Progress Reports: Submit three (3) copies of monthly progress reports, at the same time as the Application for Payment, documenting the following:

1. Material category.
2. Point of waste generation.
3. Total quantity of waste in tons.
4. Quantity of waste salvaged, in tons.
5. Quantity of waste recycled, in tons.
6. Total quantity of waste recovered (salvaged plus recycled) in tons.
7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.

D. Calculations: Submit three (3) copies of calculations indicating the end-of-project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Project prior to Substantial Completion.

E. Record Submittals:

1. Donations: Indicate which salvageable materials were donated, who they were donated to, and whether the recipient is tax exempt. Submit documentation indicating receipt of donations.
2. Sales: Indicate which salvageable materials were sold, who they were sold to, and whether the recipient is tax exempt. Submit documentation indicating receipt of materials.
3. Recycling: Indicate which materials were recycled and the name of the facility licensed to accept them. Submit documentation such as manifests, weight tickets, receipts, and invoices.
4. Waste Disposal: Indicate which materials were accepted as waste by landfills and incinerator facilities licensed to accept them. Submit documentation indicating receipt of materials.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with regulations of State of Connecticut Department of Environment Protection, Waste Management Bureau Recycling Program.

B. Waste Management Conference: Review and discuss the waste management plan, requirements for documenting quantities of each type of waste and its disposition, procedures for materials separation, procedures for periodic collection and transportation to recycling and disposal facilities. Review waste management requirements for each trade. Verify availability of containers and bins needed to avoid delays.

1.7 WASTE MANAGEMENT PLAN

A. Draft Waste Management Plan: Include the following in the Draft Plan:

1. Analysis of the proposed jobsite waste to be generated, including types and quantities.
2. Landfill Options: The name of the landfill(s) where trash will be disposed of, the applicable landfill tipping fee(s), and the projected cost of disposing of all Project waste in the landfill(s).
3. Alternatives to Landfilling: A list of each material proposed to be salvaged, reused, or recycled during the course of the Project, the proposed local market for each material, and the estimated net cost savings or additional costs resulting from separating and recycling (versus landfilling) each material. "Net" means that the following have been subtracted from the cost of separating and recycling:

a. Revenue from the sale of recycled or salvaged materials and

b. Landfill tipping fees saved due to diversion of materials from the landfill. The list of these materials is to include, at a minimum, the following materials:

i. Cardboard.

ii. Clean dimensional wood.

iii. Beverage containers.

iv. Land clearing debris.

v. Concrete.

vi. Bricks.

vii. Concrete Masonry Units (CMU).

viii. Asphalt.

ix. Metals from banding, stud trim, ductwork, piping, rebar, roofing, other trim, steel, iron, galvanized sheet steel, stainless steel, aluminum, copper, zinc, lead, brass, and bronze.

B. Resources for Development of Waste Management Plan: The following sources may be useful in developing the Draft Waste Management Plan:

1. Recycling Haulers and Markets: Local haulers and markets for recyclable materials. For more information, contact the State of Connecticut Department of Environmental Protection, Waste Management Bureau Recycling Program, (860) 424-3365, www.dep.state.ct.us/wst/recycle/ctrecycle.htm.

C. Final Waste Management Plan: The Final Waste Management Plan shall contain the following:

1. Analysis of the proposed jobsite waste to be generated, including types and quantities.

2. Landfill Options: The name of the landfill(s) where trash will be disposed of, the applicable landfill tipping fee(s), and the projected cost of disposing of all Project waste in the landfill(s).

3. Alternatives to Landfilling: A list of the waste materials from the Project that will be separated for reuse, salvage, or recycling.

4. Meetings: A description of the regular meetings to be held to address waste management. Refer to Section 01 31 19 "Project Meetings".

5. Materials Handling Procedures: A description of the means by which any waste materials identified in item (3) above will be protected from contamination, and a description of the means to be employed in recycling the above materials consistent with requirements for acceptance by designated facilities.

6. Transportation: A description of the means of transportation of the recyclable materials (whether materials will be site-separated and self-hauled to designated centers, or whether mixed materials will be collected by a waste hauler and removed from the site) and destination of materials.

1.8 WASTE MANAGEMENT PLAN IMPLEMENTATION

A. Manager: The Construction Manager shall designate an on-site party (or parties) responsible for instructing workers and overseeing and documenting results of the Waste Management Plan for the Project.

B. Distribution: The Construction Manager shall distribute copies of the Waste Management Plan to the Job Site Foreman, each Subcontractor, the Owner, and the Architect.

C. Instruction: The Construction Manager shall provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the Project.

D. Separation Facilities: The Construction Manager shall lay out and label a specific area to facilitate separation of materials for potential recycling, salvage, reuse, and return. Recycling and waste bin areas are to be kept neat and clean and clearly marked in order to avoid contamination of materials.

E. Hazardous Wastes: Hazardous wastes shall be separated, stored, and disposed of according to local regulations.

F. Application for Progress Payments: The Construction Manager shall submit with each Application for Progress Payment a Summary of Waste Generated by the Project. Failure to submit this information shall render the Application for Payment incomplete and shall delay Progress Payment. The Summary shall be submitted on a form acceptable to the Owner and shall contain the following information:

1. The amount (in tons or cubic yards) of material landfilled from the Project, the identity of the landfill, the total amount of tipping fees paid at the landfill, and the total disposal cost. Include manifests, weight tickets, receipt, and invoices.

2. For each material recycled, reused, or salvaged from the Project: the amount (in tons or cubic yards), the date removed from the jobsite, the receiving party, the transportation cost, the amount of any money paid or received for the recycled or salvaged material, and the net total cost or savings of salvage or recycling of each material shall be indicated. Attach manifests, weight tickets, receipts, and invoices.

PART 2 – PRODUCTS

(Not Applicable)

PART 3 – EXECUTION

3.1 PLAN IMPLEMENTATION

A. Implement the waste management plan as approved by [Architect] [Owner] [Owner's Representative].

B. Provide training of workers, Construction Manager's staff, subcontractors, and suppliers on proper waste management procedures.

1. Distribute waste management plan to all parties involved in the Project within [three (3)] [Insert] days of submittal return.

2. Distribute plan to parties when they first begin working on the Project site. Review plan procedures and locations established for salvage, recycling, and disposal.

3.2 SEPARATION OF RECYCLABLE WASTE MATERIALS

A. Provide the necessary containers and bins, to facilitate the waste management program, that are clearly and appropriately marked. Prevent contamination of recyclable materials from incompatible products and materials. Separate construction waste at the project site by one of the following methods:

1. Source Separated Method: Waste products and materials, that are recyclable, are separated from trash and sorted into appropriately marked separate containers and then transported to the respective recycling facility for further processing. Trash is transported to a landfill or incinerator.

2. Co-Mingled Method: All construction waste is placed into a single container and then transported to a recycling facility where the recyclable materials are sorted and processed and the remaining trash is transported to a landfill or incinerator.

3. Other methods proposed by the Construction Manager and approved by the [Architect] [Owner] [Owner's Representative].

END OF SECTION 01 74 19 - CMR

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Construction Documents and general provisions of the CMR Agreement Between Owner and Construction Manager and the Guaranteed Maximum Price (GMP) Amendment, including Division 00 General Conditions of the Contract for Construction – CMR and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for handling requests for building system start up and system demonstration and includes the following:

1. Starting Systems.
2. Demonstration and instructions.
3. Testing, adjusting, and balancing.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 01 Section 01 45 00 "Quality Control - CMR" specifies quality assurance and inspecting services.

2. Division 01 Section 01 77 00 " Closeout Procedures - CMR" specifies requirements for contract close out requirements for system operation and maintenance data and extra materials.

3. Division 01, Section 01 91 00 "Commissioning - CMR" specifies process requirements for system commissioning.

4. Division 23, Section 23 08 00 "Commissioning of HVAC - CMR" specifies requirements HVAC&R system commissioning.

1.3 STARTING SYSTEMS

A. Coordinate schedule for start-up of various equipment and systems.

B. Provide written notification to the Owner's Representative and Commissioning Agent thirty (30) days prior to start-up of each item.

C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, and control sequence for other conditions that may cause damage.

D. Verify that tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.

E. Verify that wiring and support components are complete and tested.

F. Execute the start-up under supervision of manufacturer's representative, in accordance with manufacturer's instructions.

G. When referenced in individual specification sections, require manufacturer to provide an authorized representative to be present at the site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.

H. Submit a written report in accordance with Division 01 Section 01 45 00 "Quality Control" that the equipment or system has been properly installed and is functioning properly.

1.4 DEMONSTRATION AND INSTRUCTIONS

A. Demonstrate operation and maintenance of Products to Owner and Agency Personnel fourteen (14) days prior to substantial completion.

B. Demonstrate Project equipment and instruct in a classroom environment at location designated by the Owner's Representative and CTDCS PM and instructed by a qualified manufacturer's representative who is knowledgeable about the Project.

C. For equipment or systems requiring seasonal operation perform demonstration for season within six (6) months.

D. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owner and Agency Personnel in detail to explain all aspects of operation and maintenance.

E. Demonstrate start-up, operation, control, adjustment, troubleshooting, servicing, and maintenance, and shutdown of each item at agreed upon scheduled time and at equipment or designated location.

F. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during demonstration.

G. Starting and adjusting equipment does not constitute acceptance by the owner since commissioning is a requirement of this contract. Additionally, the warrantee does not begin until substantial completion has been granted for that specific item.

1.5 TESTING, ADJUSTING, AND BALANCING

A. The Construction Manager will employ and pay for the testing services of an independent consultant to verify the testing, adjusting, and balancing.

1. Comply with the requirements of Division 01 Section 01 91 00 "Commissioning - CMR" as they relate to the Work of this Section.

B. Reports will be submitted by the independent testing consultant to the Owner's Representative indicating observations and results of tests and indicating compliance or non-compliance with the requirements of the Contract Documents.

C. The Owner may employ and pay for the services of an independent consultant to verify testing, adjusting, and balancing which was performed by the Construction Manager.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01 75 00 - CMR

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Construction Documents and general provisions of the CMR Agreement Between Owner and Construction Manager and the Guaranteed Maximum Price (GMP) Amendment, including Division 00 General Conditions of the Contract for Construction – CMR and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for contract closeout including, but not limited to, the following:

1. Inspection procedures.
2. Project record document submittal.
3. Operation and maintenance manual submittal.
4. Submittal of warranties.
5. Final cleaning.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 01 Section 01 11 00 "Summary of Work - CMR".

2. Division 01 Section 01 29 76 "Progress Payment Procedures - CMR".

C. Closeout requirements for specific construction activities and commissioning may be included in the appropriate Sections in Divisions 02 through 49.

1.3 SUBSTANTIAL COMPLETION

A. General: Basic contract definitions are included in Article 1 of the Division 00 General Conditions of the Contract for Construction - CMR.

B. Preliminary Procedures: Before requesting inspection for Certification of Substantial Completion, complete the following. List exceptions in the request.

1. In the Application for Payment that coincides with, or first follows, the date Substantial Completion is claimed, show 100 percent completion for the portion of the Work claimed as substantially complete.

a. Include supporting documentation for completion as indicated in these Contract Documents and a statement showing an accounting of changes to the Contract Sum.

b. If 100 percent completion cannot be shown, include a list of incomplete items, the value of incomplete construction, and reasons the Work is not complete.

2. Advise the Owner of pending insurance changeover requirements.

3. Submit specific warranties, workmanship bonds, maintenance agreements, final certifications, and similar documents.

4. Obtain and submit releases enabling the Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, certificates of compliance, operating certificates, and similar releases.

5. Submit record drawings, maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.

6. Deliver tools, spare parts, extra stock, and similar items.

7. Make final changeover of permanent locks and transmit keys to the Owner. Advise the Owner's personnel of changeover in security provisions.

8. Demonstrate, thru operation and testing, the functions of all systems and/or equipment to the satisfaction of the Owner for compliance to the Contract. Complete testing of systems and instruction of the Owner's operation and maintenance personnel. Discontinue and remove temporary facilities from the site, along with mockups, construction tools, and similar elements.

9. Complete final cleanup requirements.

10. Certify that required training of personnel is complete.

C. Inspection Procedures: The Construction Manager shall be ready and prepared when they request a Substantial Completion inspection. If the inspection reveals that the work is not complete, that there are extensive punchlist items that will take more than ninety (90) days to complete and as the items listed in Article 1.3 above are not complete, the Owner's Representative, Architect, and Owner will determine the inspection has failed.

D. The Construction Manager is responsible for all costs to re-inspect due to a failed inspection. The Owner will issue a deduct change order to cover all costs for re-inspection.

1. The Architect will repeat inspection when requested and assured that the Work is substantially complete.

2. Results of the completed inspection will form the basis of requirements for final acceptance.

1.4 ACCEPTANCE

A. Preliminary Procedures: Before requesting final inspection for "Certificate of Acceptance" and final payment, complete the following. List exceptions in the request.

1. Submit the final payment request with releases and supporting documentation not previously submitted and accepted. Include insurance certificates for products and completed operations where required.

2. Submit an updated final statement, accounting for final additional changes to the Contract Sum.

3. Submit a certified copy of the Architect's final inspection list of items to be completed or corrected, endorsed and dated by the Architect. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance and shall be endorsed and dated by the Architect.

4. Submit final meter readings for utilities, a measured record of stored fuel, and similar data as of the date of Substantial Completion or when the Owner took possession of and assumed responsibility for corresponding elements of the Work.

5. Submit consent of surety to Final Payment.

6. Submit evidence of final, continuing insurance coverage complying with insurance requirements.

7. Touch up and otherwise repair and restore marred, exposed finishes, including touchup painting.

B. Re-inspection Procedure: The designated Inspection Group will re-inspect the Work upon receipt of notice from the Owner's Representative that the Work, including inspection list items from earlier inspections, has been completed, except for items whose completion is delayed under circumstances acceptable to the Owner.

1. Upon completion of re-inspection, the Owner's Representative and CTDCS PM will prepare a Certificate of Acceptance. If the Work is incomplete, Owner's Representative will advise the Construction Manager of Work that is incomplete or of obligations that have not been fulfilled but are required for final acceptance.

1.5 AS-BUILT DOCUMENT SUBMITTALS

A. General: The Construction Manager shall not use As-built Drawings for construction purposes. Protect Construction Manager As-built Drawings from deterioration and loss in a secure, fire-resistant location. Provide access to As-built Drawings for the Architect's reference during normal working hours. Keep documents current; do not permanently conceal any work until required information has been recorded. IMPORTANT NOTE: Failure to keep As-built Documents current is sufficient cause to withhold progress payments.

1. The Construction Manager shall also hire the services of a Surveyor registered in the State of Connecticut to conduct a final survey to determine the location of exterior underground utility lines and to record the results, and update existing electronic media.

2. The record of exterior underground utilities shall be made at the time of installation on Mylar film drawing and AutoCAD (latest version) compatible disks. The drawing shall bear the seal of the Land Surveyor and a statement of accuracy.

B. As-built Drawings: The Construction Manager shall maintain one (1) clean, complete undamaged set of blue or black line white-prints of Contract Drawings and Shop Drawings. Mark the set to show the actual installation where the installation varies substantially from the Work as originally shown. Mark which drawing is most capable of showing conditions fully and accurately. Where Shop Drawings are used, record a cross-reference at the corresponding location on the Contract Drawings. Give particular attention to concealed elements that would be difficult to measure and record at a later date. Update As-built Drawings on a monthly basis coincident with the submittal of the Application for Payment.

1. Mark record sets with erasable pencil to distinguish between variations in separate categories of the Work.

2. Mark all new information that is not shown on Contract Drawings.

3. Note related change-order numbers where applicable.

4. Organize record drawing sheets into manageable sets. Bind sets with durable-paper cover sheets; print suitable titles, dates, and other identification on the cover of each set.

5. Upon completion of the work, the Construction Manager shall submit Record Drawings to the Owner's Representative for the Owner's Records who will pass them on to the Architect or Engineer for transferring the changes to the Record Drawing Mylar Tracings.

6. Submit electronic format data of all Coordination Drawings as required by the Owner, at no additional cost.

7. Refer to Section 01 45 00 "Quality Control - CMR", Article 1.3 for required as-built drawings and specifications for fire alarm systems.

C. Record Specifications: The Construction Manager shall maintain one (1) complete copy of the Project Manual, including Addenda. Include with the Project Manual one (1) copy of other written construction documents, such as Change Orders and modifications issued in printed form during construction.

1. Mark these documents to show substantial variations in actual Work performed in comparison with the text of the Specifications and modifications.

2. Give particular attention to equals and substitutions and selection of options and information on concealed construction that cannot otherwise be readily discerned later by direct observation.

3. Note related record drawing information and Product Data.

4. Upon completion of the Work, submit Record Specifications to the Owner's Representative for the Owner's records.

D. Record Product Data: The Construction Manager shall maintain one (1) copy of each Product Data submittal. Note related Change Orders and markup of record drawings and Specifications.

1. Mark these documents to show significant variations in actual Work performed in comparison with information submitted. Include variations in products delivered to the site and from the manufacturer's installation instructions and recommendations.
2. Give particular attention to concealed products and portions of the Work that cannot otherwise be readily discerned later by direct observation.
3. Upon completion of markup, submit complete set of Record Product Data to the Owner's Representative for the Owner's records.

E. Record Sample Submitted: Immediately prior to Substantial Completion, the Construction Manager shall meet with the Owner's Representative, Architect and the Owner's personnel at the Project Site to determine which Samples are to be transmitted to the Owner for record purposes. Comply with the Owner's instructions regarding delivery to the Owner's Sample storage area.

F. Miscellaneous Record Submittals: Refer to other Specification Sections for requirements of miscellaneous record keeping and submittals in connection with actual performance of the Work. Immediately prior to the date or dates of Substantial Completion, complete miscellaneous records and place in good order. Identify miscellaneous records properly and bind or file, ready for continued use and reference. Submit to the Owner's Representative for the Owner's records.

G. Maintenance Manuals: Organize operation and maintenance data into suitable sets of manageable size. Bind properly indexed data in individual, heavy-duty, 2-inch, 3-ring, vinyl-covered binders, with pocket folders for folded sheet information. Mark appropriate identification on front and spine of each binder according to Division 01 Section 01 78 23 "Operation & Maintenance Data - CMR". Included but not limited to the following types of information:

1. Spare parts list.

2. Copies of warranties.

3. Wiring diagrams.

4. Recommended "turn-around" cycles.

5. Inspection procedures.

6. Shop Drawings and Product Data.

7. Fixture lamping schedule.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 CLOSEOUT PROCEDURES

A. Operation and Maintenance Instructions: Arrange for each Installer of equipment that requires regular maintenance to meet with the Owner's personnel to provide instruction in proper operation and maintenance. Provide instruction by manufacturer's representatives if installers are not experienced in operation and maintenance procedures. Include a detailed review of the following items:

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1. Maintenance manuals.
2. Record documents.
3. Spare parts and materials.
4. Tools.

5. Lubricants.
6. Fuels.
7. Identification systems.
8. Control sequences.
9. Hazards.
10. Cleaning.
11. Warranties and bonds.
12. Maintenance agreements and similar continuing commitments.

B. As part of instruction for operating equipment, demonstrate the following procedures:

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1. *Startup.*
2. *Shutdown.*
3. *Emergency operations.*
4. *Noise and vibration adjustments.*
5. *Safety procedures.*
6. *Economy and efficiency adjustments.*
7. *Effective energy utilization.*

3.2 FINAL CLEANING

A. General: The General Conditions require general cleaning during construction. Regular site cleaning is included in Division 01 Section 01 50 00 "Temporary Facilities and Controls - CMR."

B. Cleaning: Employ professional cleaners for final cleaning. Clean each surface or unit to the condition expected in a normal, commercial building cleaning and maintenance program. Comply with manufacturer's instructions.

1. Complete the following cleaning operations before requesting inspection for Certification of Substantial Completion and Certification of Occupancy.

2. Interior:

a. Remove labels that are not permanent labels.

b. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other substances that are noticeable vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Remove paint spots; wash and polish glass.

c. Clean exposed interior hard-surfaced finishes to a dust-free condition, free of stains, films, and similar foreign substances. Restore reflective surfaces to their original condition. Leave concrete floors broom clean. Vacuum carpeted surfaces.

d. Wash washable surfaces of mechanical, electrical equipment and fixtures and replace filters, clean strainers on mechanical equipment. Remove excess lubrication and other substances. Clean plumbing fixtures to a sanitary condition. Clean light fixtures and lamps.

e. Clean and polish finish hardware.

f. Clean and polish tile and other glazed surfaces.

g. Clean floors; wax and buff resilient tile. Clean vinyl or rubber base.

h. Vacuum and/or dust walls, ceilings, lighting fixtures, ceiling diffusers and other wall and ceiling items.

i. Remove defacements, streaks, fingerprints and erection marks.

3. Exterior:

a. Clean the site, including landscape development areas, of rubbish, litter, and other foreign substances. Sweep paved areas broom clean; remove stains, spills, and other foreign deposits. Rake grounds that are neither paved nor planted, to a smooth, even-textured surface.

b. Clean exposed exterior hard-surfaced finishes to a dust-free condition, free of stains, films, and similar foreign substances.

c. Clean roofs, gutters and downspouts.

d. Remove waste and surplus materials, rubbish and construction equipment and facilities from the site, and deposit it legally elsewhere.

e. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other substances that are noticeable vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Remove paint spots; wash and polish glass.

C. Pest Control: Engage an experienced, licensed exterminator to make a final inspection and rid the work of rodents, insects, and other pests. Provide results of final inspection in writing.

D. Removal of Protection: Remove temporary protection and facilities installed for protection of the Work during construction.

E. Compliance: Comply with regulations of authorities having jurisdiction and safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on the Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from the site and dispose of lawfully.

1. Where extra materials of value remain after completion of associated Work, they become the Owner's property. Dispose of these materials as directed by the Owner's Representative and CTDCS PM.

2. Leave building clean and ready for occupancy. If the Construction Manager fails to clean up, the Owner may do so, with the cost charged to the Construction Manager. The Owner will issue a credit change order to cover the costs.

END OF SECTION 01 77 00 - CMR

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Construction Documents and general provisions of the CMR Agreement Between Owner and Construction Manager and the Guaranteed Maximum Price (GMP) Amendment, including Division 00 General Conditions of the Contract for Construction – CMR and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for operation and maintenance manuals, including the following:

1. Preparing and submitting operation and maintenance manuals for building operating systems and equipment.

2. Preparing and submitting instruction manuals covering the care, preservation, and maintenance of architectural products and finishes.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 01 Section 01 33 00 "Submittal Procedures - CMR" specifies preparation of Shop Drawings and Product Data.

2. Division 01 Section 01 75 00 "Starting and Adjusting - CMR" specifies instruction of the Owner and Agency operating personnel in the operation and maintenance of building systems and equipment and the general requirements for starting-up equipment and systems.

3. Division 01 Section 01 77 00 "Closeout Procedures - CMR" specifies general closeout requirements.

4. Division 01 Section 01 78 30 "Warranties and Bonds - CMR" specifies requirements for submittal of warranties and bonds.

5. Division 01 Section 01 81 13 "Sustainable Design Requirements - CMR" specifies requirements for submittals related to green building certification.

6. Division 01 Section 01 91 00 “Commissioning – CMR” specifies requirements for submittals related Commissioning.

7. Appropriate Sections of Divisions 02 through 49 specify special operation and maintenance data requirements for specific pieces of equipment or building operating systems.

1.3 QUALITY ASSURANCE

A. Maintenance Manual Preparation: In preparation of maintenance manuals, use personnel thoroughly trained and experienced in operation and maintenance of equipment or system involved.

1. Where maintenance manuals require written instructions, use personnel skilled in technical writing where necessary for communication of essential data.

2. Where maintenance manuals require drawings or diagrams, use draftsmen capable of preparing drawings clearly in an understandable format.

B. Instructions for the Owner and Agency Personnel: The Construction Manager must use experienced instructors thoroughly trained and experienced in operation and maintenance of equipment or system involved, to instruct the Owner's operation and maintenance personnel.

C. Commissioning (Cx) Coordination: The Commissioning process requires detailed O&M documentation. The Construction Manager must submit O&M manuals to the Owner's Representative for review and approval by Commissioning Agent (CxA).

1.4 SUBMITTALS

A. Submittal Schedule: Comply with the following schedule for submitting operation and maintenance manuals:

1. Before Substantial Completion, when each installation that requires operation and maintenance manuals is nominally complete, submit four (4) draft copies of each manual to the Owner's Representative, Commissioning Agent (CxA), Agency Representative, and Architect for review. Include a complete index or table of contents of each manual.

a. The Owner's Representative will return one (1) copy of the draft with comments within twenty - one (21) calendar days of receipt.

b. Submit four (4) copies of data in final form at least twenty-one (21) calendar days before final inspection. The Owner's Representative will return one (1) copy within twenty-one (21) calendar after final inspection, with comments.

2. After final inspection, make corrections or modifications to comply with the Commissioning Agent's (CxA), Architect's, and Agency Representative's comments. Submit final copies to the Owner's Representative within twenty-one (21) calendar days of receipt of the Commissioning Agent's (CxA), Architect's, and Agency Representative's comments.

B. Form of Submittal: Prepare operation and maintenance manuals in the form of an instructional manual for use by the Owner's operating personnel. Organize into suitable sets of manageable size. Where possible, assemble instructions for similar equipment into a single binder.

1. Binders: For each manual, provide heavy-duty, commercial-quality, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to receive 8-1/2-by-11- inch paper. Provide a clear plastic sleeve on the spine to hold labels describing contents. Provide pockets in the covers to receive folded sheets.

a. Where two (2) or more binders are necessary to accommodate data, correlate data in each binder into related groupings according to the Project Manual table of contents. Cross-reference other binders where necessary to provide essential information for proper operation or maintenance of the piece of equipment or system.

b. Identify each binder on front and spine, with the printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter covered. Indicate volume number for multiple volume sets of manuals.

2. Dividers: Provide heavy paper dividers with celluloid-covered tabs for each separate section. Mark each tab to indicate contents. Provide a typed description of the product and major parts of equipment included in the section on each divider.

3. Protective Plastic Jackets: Provide protective, transparent, plastic jackets designed to enclose diagnostic software for computerized electronic equipment.

4. Text Material: Where maintenance manuals require written material, use the manufacturer's standard printed material. If manufacturer's standard printed material is not available, provide specially prepared data, neatly typewritten, on 8-1/2-by-11-inch, 20-lb/sq ft white bond paper.

5. Drawings: Where maintenance manuals require drawings or diagrams, provide reinforced, punched binder tabs on drawings and bind in with text.

a. Where oversize drawings are necessary, fold drawings to the same size as text pages and use as a foldout.

b. If drawings are too large to be used practically as a foldout, place the drawing, neatly folded, in front or rear pocket of binder. Insert a typewritten page indicating drawing title, description of contents, and drawing location at the appropriate location in the manual.

1.5 MANUAL CONTENT

A. In each manual include information specified in the individual Specification Section and the following information for each major component of building equipment and its controls:

1. General system or equipment description.

2. Design factors and assumptions.

3. Copies of applicable shop drawings and product data.

4. System or equipment identification, including:

a. Name of manufacturer.

b. Model number.

c. Serial number of each component.

5. Operating instructions.

6. Emergency instructions.

7. Wiring diagrams.

8. Inspection and test procedures.

9. Maintenance procedures and schedules.

10. Precautions against improper use and maintenance.

11. Copies of warranties.

12. Repair instructions including spare parts listing.

13. Sources of required maintenance materials and related services.

14. Manual index.

B. Organize each manual into separate sections for each piece of related equipment. As a minimum, each manual shall contain a title page; a table of contents; copies of product data, supplemented by drawings and written text; and copies of each warranty, bond, and service contract issued.

1. Title Page: Provide a title page in a transparent, plastic envelope as the first sheet of each manual. Provide the following information:

a. Subject matter covered by the manual.

b. Name and address of the Project.

c. Date of submittal.

d. Name, address, and telephone number of the Construction Manager.

e. Name and address of the Architect and Owner's Representative.

f. Cross-reference to related systems in other operation and maintenance manuals.

2. Table of Contents: After title page, include a typewritten table of contents for each volume, arranged systematically according to the Project Manual format. Include a list of each product included, identified by product name or other appropriate identifying symbol and indexed to the content of the volume.

a. Where a system requires more than one volume to accommodate data, provide a comprehensive table of contents for all volumes in each volume of the set.

3. Provide a general information section immediately following table of contents, listing each product included in the manual, identified by product name. Under each product, list the name, address, and telephone number of the subcontractor or Installer and the maintenance subcontractor. Clearly delineate the extent of responsibility of each of these entities. Include a local source for replacement parts and equipment.

4. Product Data: Where the manuals include manufacturer's standard printed data, include only sheets that are pertinent to the part or product installed. Mark each sheet to identify each part or product included in the installation. Where the Project includes more than one (1) item in a tabular format, identify each item, using appropriate references from the Contract Documents. Identify data that is applicable to the installation, and delete references to information that is not applicable.

5. Written Text: Prepare written text to provide necessary information where manufacturer's standard printed data is not available, and the information is necessary for proper operation and maintenance of equipment or systems. Prepare written text where it is necessary to provide additional information or to supplement data included in the manual. Organize text in a consistent format under separate headings for different procedures. Where necessary, provide a logical sequence of instruction for each operation or maintenance procedure.

6. Drawings: Provide specially prepared drawings where necessary to supplement manufacturer's printed data to illustrate the relationship of component parts of equipment or systems or to provide control or flow diagrams. Coordinate these drawings with information contained in project record drawings to assure correct illustration of the completed installation.

a. Do not use original Record Documents as part of operation and maintenance manuals.

7. Warranties and/or Bonds: Provide a copy of each warranty and/or bond in the appropriate manual for the information of the Owner's operating personnel. Provide written data outlining procedures to follow in the event of product failure. List circumstances and conditions that would affect validity of warranty or bond.

1.6 MATERIAL AND FINISHES MAINTENANCE MANUAL

A. Submit four (4) copies of each manual, in final form, on material and finishes to the Owner’s Representative for distribution. Provide one (1) section for architectural products, including applied materials and finishes. Provide a second section for products designed for moisture protection and products exposed to the weather.

1. Refer to individual Specification Sections for additional requirements on care and maintenance of materials and finishes.

B. Architectural Products: Provide manufacturer's data and instructions on care and maintenance of architectural products, including applied materials and finishes.

1. Manufacturer's Data: Provide complete information on architectural products, including the following, as applicable:

a. Manufacturer's catalog number.

b. Size.

c. Material composition.

d. Color.

e. Texture.

f. Reordering information for specially manufactured products.

2. Care and Maintenance Instructions: Provide information on care and maintenance, including manufacturer's recommendations for types of cleaning agents to be used and

methods of cleaning. Provide information on cleaning agents and methods that could prove detrimental to the product. Include manufacturer's recommended schedule for cleaning and maintenance.

C. Moisture Protection and Products Exposed to the Weather: Provide complete manufacturer's data with instructions on inspection, maintenance, and repair of products exposed to the weather or designed for moisture-protection purposes.

1. Manufacturer's Data: Provide manufacturer's data giving detailed information, including the following, as applicable:

   a. Applicable standards.

   b. Chemical composition.

   c. Installation details.

   d. Inspection procedures.

   e. Maintenance information.

   f. Repair procedures.

1.7 EQUIPMENT AND SYSTEMS MAINTENANCE MANUAL

A. Submit four (4) copies of each manual, in final form, on equipment and systems to the Owner’s Representative for distribution. Provide separate manuals for each unit of equipment, each operating system, and each electric and electronic system.

1. Refer to individual Specification Sections for additional requirements on operation and maintenance of the various pieces of equipment and operating systems.

B. Equipment and Systems: Provide the following information for each piece of equipment, each building operating system, and each electric or electronic system.

1. Description: Provide a complete description of each unit and related component parts, including the following:

   a. Equipment or system function.

   b. Operating characteristics.

   c. Limiting conditions.

   d. Performance curves.

   e. Engineering data and tests.

   f. Complete nomenclature and number of replacement parts.

2. Manufacturer's Information: For each manufacturer of a component part or piece of equipment, provide the following:

   a. Printed operation and maintenance instructions.

   b. Assembly drawings and diagrams required for maintenance.

   c. List of items recommended to be stocked as spare parts.

3. Maintenance Procedures: Provide information detailing essential maintenance procedures, including the following:

4. Operating Procedures: Provide information on equipment and system operating procedures, including the following:

   a. Startup procedures.

   b. Equipment or system break-in.

   c. Routine and normal operating instructions.

   d. Regulation and control procedures.

e. Instructions on stopping.

f. Shutdown and emergency instructions.

g. Summer and winter operating instructions.

h. Required sequences for electric or electronic systems.

i. Special operating instructions.

5. Servicing Schedule: Provide a schedule of routine servicing and lubrication requirements, including a list of required lubricants for equipment with moving parts.

6. Controls: Provide a description of the sequence of operation and as-installed control diagrams by the control manufacturer for systems requiring controls.

7. Identification Drawings: Provide each Subcontractor's Identification Drawings.

a. Provide as-installed, color-coded, piping diagrams, where required for identification.

8. Valve Tags: Provide charts of valve-tag numbers, with the location and function of each valve.

9. Circuit Directories: For electric and electronic systems, provide complete circuit directories of panel boards, including the following:

a. Controls.

b. Communication.

C. Electronic Media:

1. For equipment which requires maintenance by operational personnel, provide a DVD developed to a level of quality acceptable to the Owner for the use of maintenance training for the facility. Each DVD will be accompanied by a written index which can be utilized to find any specific item of information by time or place on the DVD.

2. The Construction Manager is responsible for this production. This DVD will be provided to the Owner's Representative at the same time as the delivery of the other maintenance material.

3. The DVD must be able to be edited for future changes to the equipment and modifications as they occur.

1.8 COMMISSIONING RECORD AND TESTING DATA MANUAL

A. The CMR shall cooperate with Commissioning Agent (CxA) in the preparation of a separate Manual dedicated to documenting the Commissioning process which will include all certifications and testing data and some repeating of O&M data. Description of this Manual is found in Section 01 91 00 Commissioning – CMR and shall be prepared by the Commissioning Agent (CxA).

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01 78 23 - CMR

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Construction Documents and general provisions of the CMR Agreement Between Owner and Construction Manager and the Guaranteed Maximum Price (GMP) Amendment, including Division 00 General Conditions of the Contract for Construction – CMR and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for warranties required by the Contract Documents, including manufacturer's standard warranties on products and special warranties.

1. Refer to the General Conditions for terms of the Construction Manager's period for correction of the Work.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 01 Section 01 33 00 "Submittal Procedures - CMR" specifies procedures for submitting warranties.

2. Division 01 Section 01 77 00 "Closeout Procedures - CMR" specifies contract closeout procedures.

3. Division 01 Section 01 78 23 "Operation and Maintenance Data- CMR" specifies required operation and maintenance data.

4. Divisions 02 through 49 Sections for specific requirements for warranties on products and installations specified to be warranted.

5. Certifications and other commitments and agreements for continuing services to Owner are specified elsewhere in the Contract Documents.

C. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve the Construction Manager of the warranty on the Work that incorporates the products. Manufacturer's disclaimers and limitations on product warranties do not relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with the Construction Manager.

1.3 WARRANTY REQUIREMENTS

A. Related Damages and Losses: When correcting failed or damaged warranted construction, remove and replace construction that has been damaged as a result of such failure or must be removed and replaced to provide access for correction of warranted construction.

B. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.

C. Replacement Cost: Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of the Contract Documents. The Construction Manager is responsible for the cost of replacing or rebuilding defective Work regardless of whether the Owner has benefited from use of the Work through a portion of its anticipated useful service life.

D. Owner's Recourse: Expressed warranties made to the Owner are in addition to implied warranties and shall not limit the duties, obligations, rights, and remedies otherwise available under the law. Expressed warranty periods shall not be interpreted as limitations on the time in which the Owner can enforce such other duties, obligations, rights, or remedies.

1. Rejection of Warranties: The Owner reserves the right to reject warranties and to limit selection to products with warranties not in conflict with requirements of the Contract Documents.

E. Where the Contract Documents require a special warranty, or similar commitment on the Work or part of the Work, the Owner reserves the right to refuse to accept the Work, until the Construction Manager presents evidence that entities required to countersign such commitments are willing to do so.

F. The Construction Manager shall guarantee all materials and workmanship for a period of 18 months from the date of Substantial Completion of the Work. In addition, the Construction Manager shall furnish the warranties listed below. Submit four (4) copies of each to the Owner's Representative in the supplier's standard form or in the form given below if there is no standard form available.

Specification / Warranty Table

Item No.	Section No.	Specification Product/Warranty
3.	07 5400	Single-Ply Membrane Roofing, Base Flashing and Insulation: 20 year unlimited, materials and installation, and; 20 year material and workmanship, and; 2 year Construction Manager's warranty for installation.
5.	07 6100	Metal Roofing and Siding: 20 year against rupture, cracks or perforation due to corrosion, and; 20 year for fluorocarbon finish (if used) against peeling, blistering, fading and chalking as limited by industry standards, Plus; 20 year weathertightness warranty by Construction Manager's installer.
7.	07 7200	Hatches: 5 year product and installation, including weathertightness.
8.	07 1413	Hot Fluid-Applied Waterproofing: 20 year material and workmanship.
8.	07 1416	Cold Fluid-Applied Waterproofing: 5 year material and workmanship.
10.	07 9500	Exterior Expansion Joint Covers: 5 year material and workmanship, including weathertightness.
12.	07 9200	Exterior - Interior Caulking and Sealants: 5 year, material and workmanship.
13.	07 6200	Metal Flashing and Sheet Metal: 3 year, material and workmanship.
16.	08 1400	Solid Wood Core and Mineral Core doors: Lifetime for interior doors.
18.	08 6300	Skylights: 5 Year product and installation, including weathertightness.
19.	08 7100	Closers, Locksets, Exit Bolts: Longest term offered by manufacturer for grade/class of particular item, material and workmanship.

20.	08	8000	Insulating glass: 10 year against failure of hermetic seal, interpane dusting, or misting including replacement of unit.
21.	08	5100	Aluminum Windows: 10 year material and workmanship including weathertightness.
22.	08	8000	Laminated Glass: 10 year against delamination.
23.	08	4410	Glazed Aluminum Curtain Wall: 10 year material and workmanship (insulating glass separate). Air and water infiltration and strength to specified AAMA designation.
24.	09	6810	Carpet: 10 year wear and color fastness, and; 3 year installation.
27.	14	Insert	Electric Traction Elevators: 1 year for material, workmanship, and installation.
28	22	Plumbing	Electric Heating Cable: 10 years, material, and installation.
29	22	Plumbing	Water Softener: 10 years, material, and installation.
30	22	Plumbing	Instantaneous Heat Exchangers: 1 year, material, and installation.
30	22	Plumbing	Instantaneous Heat Exchangers: 1 year, material, and installation.
32	23	HVAC	Compressors and Pumps: 5 years, material and installation,
33	26	Electrical	Dimming Controls: 8 years, material and installation,
34	26	Electrical	Switchboards and Panels: 5 years, material and installation,
35	26	Electrical	Engine Generators: 10 years, material and installation,
36	26	Electrical	Uninterruptable Power Supply: 3 years, material and installation,
37	26	Electrical	Emergency Lighting Batteries: 10 years, material and installation,
38	26	Electrical	Lighting Ballasts: 5 years, material and installation,
39	32	9200	Turf and Grasses: 12 months, material and installation, and growth.

G. Submit certification that finish materials are fire rated as specified.

H. Form of Guarantees and Warranties:

Commissioner
Department of Construction Services
165 Capitol Avenue
Hartford, Connecticut 06106
(Project Title and Number)

I (We) hereby guarantee and warranty)

the _____ work on the referenced project for a period of _____ years

from _____, 20___ against failures of workmanship and materials in accordance

with the requirements of Section ____, Page ____, Paragraph ____, of the Specifications.

Signed _____

Construction Manager's _____
(or authorized agent)

I. Bonds shall be by approved Surety Companies, made out to the Commissioner, Department of Construction Services, on company's standard form.

J. Guarantees, warranties or bonds supplied by Subcontractors, Suppliers or Manufacturers shall reference the project name, number, and location and be certified by the Construction Manager to be for the product and installation on the project and must be countersigned by the Construction Manager.

1.4 SUBMITTALS

A. Submit written warranties prior to the date certified for Substantial Completion. If the Architect's Certificate of Substantial Completion designates a commencement date for warranties other than the date of Substantial Completion for the Work, or a designated portion of the Work, submit written warranties upon request of the Architect.

B. Forms for special warranties are included in this Section. Prepare a written document utilizing the appropriate form, ready for execution by the Construction Manager, or by the, subcontractor, supplier, or manufacturer. Submit a draft to the Owner, through the Owner's Representative, for approval prior to final execution.

1. Refer to Divisions 02 through 49 Sections for specific content requirements and particular requirements for submitting special warranties.

C. Form of Submittal: At Final Completion compile two (2) copies of each required warranty properly executed by the Construction Manager, or by the subcontractor, supplier, or manufacturer. Organize the warranty documents into an orderly sequence based on the table of contents of the Project Manual.

D. Bind warranties and bonds in heavy-duty, commercial-quality, durable 3-ring, vinyl-covered loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.

1. Provide heavy paper dividers with celluloid covered tabs for each separate warranty. Mark the tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product, and the name, address, and telephone number of the Installer.

2. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project title or name, and name of the Construction Manager.

3. When warranted construction requires operation and maintenance manuals, provide additional copies of each required warranty, as necessary, for inclusion in each required manual.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not applicable)

END OF SECTION 01 78 30 - CMR

SECTION 018110

SUSTAINABLE DESIGN REQUIREMENTS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: General requirements and procedures for compliance with U.S. Green Building Council's (USGBC) Leadership in Energy & Environmental Design (LEED) prerequisites and credits needed for the Project to obtain certification based on LEED Reference Guide for Green Building Design and Construction, 2009 Edition; LEED for New Construction.

1. Compliance with requirements needed to obtain LEED prerequisites and credits may be used as one criterion to evaluate substitution requests.
   a. Refer to the LEED Scorecard Summary attached at the end of this Section for required credits.
      1) Certification goal is Silver.
      2) A Silver Rating is obtained for buildings that earn between 50 and 59 of the available 110 points.
   b. Owner shall register project with USGBC and pay USGBC registration fees.
   c. Owner shall pay USGBC costs of interpretations, certification and other administrative fees.
2. State of Connecticut, Capital Projects, High Performance Buildings Requirements: Compliance with requirements needed to satisfy the requirements of Connecticut General Statutes (CGS) Section 16a-38k.
   a. Compliance with Section 16a-38-4: Building Standard Strategies for State Facilities shall be satisfied by the compliance alternative identified in Section 16a-38k-7: Alternative Strategies to Section 16a-38k -4 of the Regulations of Connecticut State Agencies.
      1) The Project shall meet the requirements of Section 16a-38k-4 by receiving a Leadership in Energy and Environmental Design (LEED) Silver level certification from the United States Green Building Council.
      2) The Project must include all mandatory requirements within sections 16a-38k-3 and 16a-38k-8 of the Regulations of Connecticut State Agencies.
   b. Refer to the Compliance Checklist – State Facilities for the Mandatory Building Project Requirements for All Building for a summary of the mandatory requirements required under Section 16a-38k-3

B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Divisions 01 through 33 Sections for LEED requirements specific to the work of each of these Sections. Requirements may or may not include reference to LEED.

1.3 DEFINITIONS

A. Chain-of-Custody Certificates: Certificates signed by manufacturers certifying that wood used to make products was obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship." Certificates shall include evidence that manufacturer is certified for chain of custody by an FSC-accredited certification body.

B. LEED: Leadership in Energy & Environmental Design.

C. Recycled Content: The recycled content value of a material assembly shall be determined by weight. The recycled fraction of the assembly is then multiplied by the cost of assembly to determine the recycled content value.

1. "Post-consumer" material is defined as waste material generated by households or by commercial, industrial, and institutional facilities in their role as end users of the product, which can no longer be used for its intended purpose.
2. "Pre-consumer" material is defined as material diverted from the waste stream during the manufacturing process. Excluded is reutilization of materials such as rework, regrind, or scrap generated in a process and capable of being reclaimed within the same process that generated it.

D. Regional Materials: Materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site. If only a fraction of a product or material is extracted/harvested/recovered and manufactured locally, then only that percentage (by weight) shall contribute to the regional value.

E. Solar Reflectance Index (SRI): A measure of the constructed surface's ability to reflect solar heat, as shown by a small temperature rise. It is defined so that a standard black (reflectance 0.05, emittance 0.90) is 0 and a standard white (reflectance 0.80, emittance 0.90) is 100. To calculate the SRI for a given material, obtain the reflectance value and emittance value for the material. SRI is calculated according to ASTM E 1980. Reflectance is measured according to ASTM E 903, ASTM E 1918, or ASTM C 1549. Emittance is measured according to ASTM E 408 or ASTM C 1371.

1.4 SUBMITTALS

A. General: Submit additional LEED submittals required by other Specification Sections.

B. LEED submittals are in addition to other submittals. If submitted item is identical to that submitted to comply with other requirements, submit duplicate copies as a separate submittal to verify compliance with indicated LEED requirements.

C. Project Materials Cost Data: Provide statement indicating total cost for building materials used for Project, excluding mechanical, electrical, and plumbing components, and specialty items such as elevators and equipment.

1. Include statement indicating total cost for wood-based materials used for Project, by one of the following methods:
   a. Default materials cost (45% of project budget) for the LEED project, as calculated from the project construction costs or

b. Actual materials cost, excluding labor and equipment (hard costs for Divisions 03-10, Division 31 Foundations Sections and Division 32 Paving, Site Improvements and Planting Sections).

D. LEED Action Plans: Provide preliminary submittals within 30 days of date established for commencement of the Work indicating how the following requirements will be met:

1. Credit SS 7.1: Product Data for paving materials indicating compliance with LEED requirements, including solar reflectance index (SRI) values.
2. Credit SS 7.2: Product Data for roofing materials indicating compliance with LEED requirements, including solar reflectance index (SRI) values.
3. Credit MR 2: Waste management plan, complying with Section 017419 - CONSTRUCTION WASTE MANAGEMENT & DISPOSAL.
4. Credit MR 4: List of proposed materials with recycled content. Indicate cost, post-consumer recycled content, and pre-consumer recycled content for each product having recycled content.
5. Credit MR 5: List of proposed regionally extracted, processed and manufactured materials. Indicate each product containing regional materials, including its source, cost, and percentage by weight of regional materials.
6. Credit MR 6: List of proposed rapidly renewable, processed and manufactured materials. Indicate each product containing rapidly renewable materials, including its source, cost, and percentage by weight of rapidly renewable materials.
7. Credit MR 7: List of proposed certified wood products. Indicate each product containing certified wood, including its source and cost of certified wood products.
8. Credit IEQ 3.1 and 3.2: Construction indoor-air-quality management plan complying with Section 015740 CONSTRUCTION INDOOR AIR QUALITY MANAGEMENT PLAN.
9. Credit IEQ 5: Indoor chemical and pollutant source control plan, including entryway systems and ventilation systems.

E. LEED Progress Reports: Concurrent with each monthly construction administration milestones, submit reports comparing actual construction and purchasing activities with LEED action plans for the following:

1. Credit MR 2: Waste reduction progress reports complying with Section 017419 - CONSTRUCTION WASTE MANAGEMENT & DISPOSAL.
2. Credit MR 4: Recycled content.
3. Credit MR 5: Regionally extracted, processed and manufactured materials.
4. Credit MR 6: Rapidly renewable materials.
5. Credit MR 7: Certified wood products.
6. Credit IEQ 3.1: Construction IAQ Management Plan- during construction complying with Section 015740 CONSTRUCTION INDOOR AIR QUALITY MANAGEMENT PLAN .

F. LEED Documentation Submittals:

1. Credit SS 7.1: Product Data for paving materials indicating compliance with LEED requirements, including solar reflectance index (SRI) values.
2. Credit SS 7.2: Product Data for roofing materials indicating compliance with LEED requirements, including solar reflectance index (SRI) values.
3. Credit EA 5: Product data and wiring diagrams for sensors and data collection system used to provide continuous metering of building energy-consumption performance over time.

4. Credit MR 2: Comply with Section 017419 - CONSTRUCTION WASTE MANAGEMENT & DISPOSAL.
5. Credit MR 4: Product data and certification letter indicating percentages by cost of post-consumer and pre-consumer recycled content for products having recycled content. Include statement indicating costs for each product having recycled content.
6. Credit MR 5: Product data indicating location of material manufacturer for regional materials. Include statement indicating cost for each regional material.
   a. Include statement indicating location of and distance from Project to point of extraction, harvest, or recovery for each raw material used in regional materials.
   b. Include statement indicating distance from manufacturer to Project for each regionally manufactured material.
   c. Include statement indicating percentage by cost of regional materials for each regionally manufactured product.
7. Credit MR 6: Product data and certification letter indicating percentages by weight of rapidly renewable content for products having rapidly renewable content. Include statement indicating costs for each product having rapidly renewable content.
8. Credit MR 7: Product data and FSC chain-of-custody certificates for products containing certified wood. Include the following:
   a. Statement indicating cost for each certified wood product.
   b. Statement indicating total cost for wood-based materials used for Project, including non-rented temporary construction.
   c. Vendor invoices for wood-based materials for both FSC and non-FSC materials.
9. Credit IEQ 3.1:
   a. Construction indoor-air-quality management plan.
   b. Product data for temporary filtration media.
   c. Product data for filtration media used during occupancy.
   d. Construction Documentation: Six annotated photographs at three different times during the construction period, along with a brief description of the SMACNA approach employed, documenting implementation of the indoor-air-quality (IAQ) management measures, such as protection of ducts and on-site stored or installed absorptive materials.
10. Credit IEQ 3.2: Comply with one of the following methods:
    a. Signed statement describing the building air flush-out procedures including the dates when flush-out was begun and completed and statement that filtration media was replaced after flush-out.
       1) Product data for filtration media used during flush-out and during occupancy.
    b. Report from testing and inspecting agency indicating results of indoor-air-quality testing and documentation showing compliance with indoor-air-quality testing procedures and requirements.
11. Credit IEQ 4.1: Product data for adhesives and sealants used inside the weatherproofing system and applied on-site indicating VOC content of each product used. Indicate VOC content in g/L calculated according to South Coast Air Quality Management District (SCAQMD) Rule #1168, requirements in effect on July 1, 2005, and rule amendment date January 7, 2005. Include a summary table comparing credit requirements and actual VOC levels for each product.
12. Credit IEQ 4.2: Product data for paints and coatings used inside the weatherproofing system and applied on-site indicating VOC content of each product used. Include a summary table comparing credit requirements and actual VOC levels for each product. Indicate VOC content in g/L calculated according to the following:
    a. Architectural Paints and Coatings (applied to interior walls and ceilings): Green Seal Standard GS-11, Paints, 1st Edition, May 20, 1993.

b. Anti-Corrosive and Anti-Rust Paints (applied to interior ferrous metal substrates): Green Seal Standard GC-03, Anti-Corrosive Paints, 2nd Edition, January 7, 1997.
c. Clear Wood Finishes, Floor coatings, Stains, Primers, and Shellacs: South Coast Air Quality Management District (SCAQMD) Rule #1113, Architectural Coatings", rules in effect on January 1, 2004.

13. Credit IEQ 4.3:
    a. Product data for carpet and carpet cushion indicating documentation that products meet the requirements of the Carpet and Rug Institute (CRI) Green Label Plus program. All carpet installed in the building must meet the testing and product requirements of the Carpet and Rug Institute Green Label Plus program. All carpet cushion installed in the building interior must meet the requirements of the Carpet and rug Institute Green Label program
    b. Product data for carpet adhesives indicating VOC content of each product used. Indicate VOC content in g/L calculated according to South Coast Air Quality Management District (SCAQMD) Rule #1168, requirements in effect on July 1, 2005, and rule amendment date January 7, 2005.
    c. Product data for hard surface flooring products indicating documentation that products are compliant with the FloorScore standards.
    d. Product data for interior concrete, wood, bamboo and cork floor finishes indicating VOC content of each product used. Indicate VOC content in g/L calculated according to South Coast Air Quality Management District (SCAQMD) Rule #1113, Architectural Coatings, requirements in effect on January 1, 2004.
    e. Product data for interior floor tile setting adhesives indicating VOC content of each product used. Indicate VOC content in g/L calculated according to South Coast Air Quality Management District (SCAQMD) Rule #1168, requirements in effect on July 1, 2005, and rule amendment date January 7, 2005.
14. Credit IEQ 4.4: Product data for products containing composite wood, agrifiber products and laminating adhesives indicating that they do not contain added urea-formaldehyde resin. Include statement indicating adhesives and binders used for each product.

PART 2 - PRODUCTS

2.1 RECYCLED CONTENT OF MATERIALS

A. Credit MR 4: Provide building materials with recycled content such that post-consumer recycled content plus one-half of pre-consumer recycled content constitutes a minimum of 20 percent of cost of materials used for Project.

1. Cost of post-consumer recycled content of an item shall be determined by dividing cost of post-consumer recycled content in the item by total cost of the item and multiplying by cost of the item.
2. Cost of pre-consumer recycled content of an item shall be determined by dividing weight of pre-consumer recycled content in the item by total weight of the item and multiplying by cost of the item.
3. Do not include plumbing, mechanical and electrical components, and specialty items such as elevators and equipment in the calculation.
4. Recycled content shall be defined according to ISO 14021 - Environmental labels and declarations - Self-declared environmental claims (Type II environmental labeling).

2.2 REGIONAL MATERIALS

A. Credit MR 5: Provide a minimum of 20 percent of building materials (by cost) that are regional materials.

1. Cost of regional material content of an item shall be determined by dividing cost of regional material content in the item by total cost of the item and multiplying by cost of the item.
2. Do not include plumbing, mechanical and electrical components, and specialty items such as elevators and equipment in the calculation.

2.3 CERTIFIED WOOD

A. Credit MR 7: Provide a minimum of 50 percent (by cost) of wood-based materials that are produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."

1. Wood-based materials include, but are not limited to, the following materials when made from wood, engineered wood products, or wood-based panel products:

a. Rough carpentry.
b. Miscellaneous carpentry.
c. Heavy timber construction.
d. Wood decking.
e. Metal-plate-connected wood trusses.
f. Structural glued-laminated timber.
g. Finish carpentry.
h. Architectural woodwork.
i. Wood paneling.
j. Wood veneer wall covering.
k. Wood flooring.
l. Wood lockers.
m. Wood cabinets.
n. Non-rented temporary construction, including bracing, concrete formwork, pedestrian barriers, and temporary protection.

2.4 LOW-EMITTING MATERIALS

A. Credit IEQ 4.1: For field applications that are inside the weatherproofing system, use adhesives and sealants that comply with the following limits for VOC content when calculated according to South Coast Air Quality Management District (SCAQMD) Rule #1168, requirements in effect on July 1, 2005, and rule amendment date January 7, 2005:

1. Wood Glues: 30 g/L.
2. Metal to Metal Adhesives: 30 g/L.
3. Adhesives for Porous Materials (Except Wood): 50 g/L.
4. Subfloor Adhesives: 50 g/L.
5. Plastic Foam Adhesives: 50 g/L.
6. Carpet Adhesives: 50 g/L.
7. Carpet Pad Adhesives: 50 g/L.
8. VCT and Asphalt Tile Adhesives: 50 g/L.
9. Cove Base Adhesives: 50 g/L.

10. Gypsum Board and Panel Adhesives: 50 g/L.
11. Rubber Floor Adhesives: 60 g/L.
12. Ceramic Tile Adhesives: 65 g/L.
13. Multipurpose Construction Adhesives: 70 g/L.
14. Fiberglass Adhesives: 80 g/L.
15. Contact Adhesive: 80 g/L.
16. Structural Glazing Adhesives: 100 g/L.
17. Wood Flooring Adhesive: 100 g/L.
18. Structural Wood Member Adhesive: 140 g/L.
19. Special Purpose Contact Adhesive (contact adhesive that is used to bond melamine covered board, metal, unsupported vinyl, Teflon, ultra-high molecular weight polyethylene, rubber or wood veneer 1/16 inch or less in thickness to any surface): 250 g/L.
20. Top and Trim Adhesive: 250 g/L.
21. Plastic Cement Welding Compounds: 250 g/L.
22. ABS Welding Compounds: 325 g/L.
23. CPVC Welding Compounds: 490 g/L.
24. PVC Welding Compounds: 510 g/L.
25. Adhesive Primer for Plastic: 550 g/L.
26. Sheet Applied Rubber Lining Adhesive: 850 g/L.
27. Aerosol Adhesive, General Purpose Mist Spray: 65 percent by weight.
28. Aerosol Adhesive, General Purpose Web Spray: 55 percent by weight.
29. Special Purpose Aerosol Adhesive (All Types): 70 percent by weight.
30. Other Adhesives: 250 g/L.
31. Architectural Sealants: 250 g/L.
32. Nonmembrane Roof Sealants: 300 g/L.
33. Single-Ply Roof Membrane Sealants: 450 g/L.
34. Other Sealants: 420 g/L.
35. Sealant Primers for Nonporous Substrates: 250 g/L.
36. Sealant Primers for Porous Substrates: 775 g/L.
37. Modified Bituminous Sealant Primers: 500 g/L.
38. Other Sealant Primers: 750 g/L.

B. Credit IEQ 4.2: For field applications that are inside the weatherproofing system, use paints and coatings that comply with the following limits for VOC content when calculated according to the following:

1. Architectural Paints and Coatings (applied to interior walls and ceilings): Green Seal Standard GS-11, Paints, 1st Edition, May 20, 1993.
   a. Flat Paints, Coatings, and Primers: 50 g/L.
   b. Nonflat Paints, Coatings, and Primers: 150 g/L.
2. Anti-Corrosive and Anti-Rust Paints (applied to interior ferrous metal substrates): Green Seal Standard GC-03, Anti-Corrosive Paints, 2nd Edition, January 7, 1997.
   a. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: 250 g/L.
3. Clear Wood Finishes, Floor coatings, Stains, Primers, and Shellacs: South Coast Air Quality Management District (SCAQMD) Rule #1113, Architectural Coatings", rules in effect on January 1, 2004.
   a. Clear Wood Finishes, Varnishes: 350 g/L.
   b. Clear Wood Finishes, Lacquers: 550 g/L.
   c. Floor Coatings: 100 g/L.
   d. Sealers:
      1) Waterproofing Sealers: 250 g/L.

2) Sanding Sealers: 275 g/L.
3) Other Sealers: 200 g/L.

e. Shellacs, Clear: 730 g/L.
f. Shellacs, Pigmented: 550 g/L.
g. Stains: 250 g/L.

C. Credit IEQ 4.3: For flooring systems installed in the building interior, use products that comply with the following:

1. Carpet and Carpet Cushion: Carpet and Rug Institute (CRI) Green Label Plus program.
2. Carpet Adhesives: 50 g/L.
3. Hard Surface Flooring: FloorScore standards.
4. Concrete, Wood, Bamboo And Cork Floor Finishes:
   a. Floor Coatings: 100 g/L.
   b. Sealers:
      1) Waterproofing Sealers: 250 g/L.
      2) Sanding Sealers: 275 g/L.
      3) Other Sealers: 200 g/L.
   c. Stains: 250 g/L.
5. Floor Tile Setting Adhesives: 65 g/L.

D. Credit IEQ 4.4: Do not use composite wood, agrifiber products and laminating adhesives that contain added urea-formaldehyde resins.

PART 3 - EXECUTION

3.1 MEASUREMENT AND VERIFICATION

A. Credit EA 5: Implement measurement and verification plan consistent Option D: Calibrated Simulation, Savings Estimation Method 2 in the EVO's "International Performance Measurement and Verification Protocol (IPMVP) Volume III: Concepts and Options for Determining Energy Savings in New Construction," and as further defined by the following:

B. If not already in place, install metering equipment to measure energy usage. Monitor, record, and trend log measurements.

C. Evaluate energy performance and efficiency by comparing actual to predicted performance.

D. Measurement and verification period shall cover at least one year of postconstruction occupancy.

E. Provide a process for corrective action if the results of the M&V plan indicate that energy savings are not being met.

3.2 CONSTRUCTION WASTE MANAGEMENT

A. Credit MR 2: Comply with Section 017419 - CONSTRUCTION WASTE MANAGEMENT & DISPOSAL.

3.3 CONSTRUCTION INDOOR-AIR-QUALITY MANAGEMENT

A. Credit IEQ 3.1: Comply with SMACNA's "SMACNA IAQ Guideline for Occupied Buildings under Construction," Chapter 3, November 2007.

1. If Owner authorizes use of permanent heating, cooling, and ventilating systems during construction period as specified in Section 011000 - GENERAL REQUIREMENTS, install filter media having a MERV 8 according to ASHRAE 52.2 at each return-air inlet for the air-handling system used during construction.
2. Replace all air filters immediately prior to occupancy. Replacement air filters shall have a MERV 13 according to ASHRAE 52.2.

B. Credit IEQ 3.2: Comply with one of the following requirements:

1. After construction ends, prior to occupancy and with all interior finishes installed, perform a building flush-out by supplying a total volume of 14000 cu. ft. of outdoor air per sq. ft. of floor area while maintaining an internal temperature of at least 60 deg F and a relative humidity no higher than 60 percent.

   a. <Insert operating requirements>.

2. If occupancy is desired prior to flush-out completion, the space may be occupied following delivery of a minimum of 3500 cu. ft. of outdoor air per sq. ft. of floor area to the space. Once a space is occupied, it shall be ventilated at a minimum rate of 0.30 cfm per sq. ft. of outside air or the design minimum outside air rate determined in IEQ Prerequisite 1, whichever is greater. During each day of the flush-out period, ventilation shall begin a minimum of three hours prior to occupancy and continue during occupancy. These conditions shall be maintained until a total of 14000 cu. ft./sq. ft. of outside air has been delivered to the space.

   a. <Insert operating requirements>.

3. Air-Quality Testing:

   a. Conduct baseline indoor-air-quality testing, after construction ends and prior to occupancy, using testing protocols consistent with the EPA's "Compendium of Methods for the Determination of Air Pollutants in Indoor Air," and as additionally detailed in the USGBC's "LEED 2009: Reference Guide."
   b. Demonstrate that the contaminant maximum concentrations listed below are not exceeded:

      1) Formaldehyde: 27 ppb.
      2) Particulates (PM10): 50 micrograms/cu. m.
      3) Total Volatile Organic Compounds (TVOC): 500 micrograms/cu. m.
      4) 4-Phenylcyclohexene (4-PH): 6.5 micrograms/cu. m.
      5) Carbon Monoxide: 9 ppm and no greater than 2 ppm above outdoor levels.

   c. For each sampling point where the maximum concentration limits are exceeded, conduct additional flush-out with outside air and retest the specific parameter(s) exceeded to indicate the requirements are achieved. Repeat procedure until all requirements have been met. When retesting noncomplying building areas, take samples from same locations as in the first test.

d. Air-sample testing shall be conducted as follows:

1) All measurements shall be conducted prior to occupancy but during normal occupied hours, and with building ventilation system starting at the normal daily start time and operated at the minimum outside air flow rate for the occupied mode throughout the duration of the air testing.
2) Building shall have all interior finishes installed including, but not limited to, millwork, doors, paint, carpet, and acoustic tiles. Nonfixed furnishings such as workstations and partitions are encouraged, but not required, to be in place for the testing.
3) Number of sampling locations will vary depending on the size of building and number of ventilation systems. For each portion of building served by a separate ventilation system, the number of sampling points shall not be less than one per 25,000 sq. ft. or for each contiguous floor area, whichever is larger, and shall include areas with the least ventilation and greatest presumed source strength.
4) Air samples shall be collected between 3 and 6 feet from the floor to represent the breathing zone of occupants, and over a minimum four-hour period.

3.4 LEED SCORECARD

A. Comply with requirements of Scorecard Summary as attached to this Section.

3.5 MATERIALS CREDITS DOCUMENTATION SHEET

A. Documentation Sheet: Provide documentation for each material required for LEED Documentation as follows:

3.6 COMPLIANCE CHECKLIST—STATE FACILITIES

A. Comply with requirements of the Mandatory Building Project Requirements for All Building as attached to this Section.

LEED 2009 for New Construction and Major Renovations

Project Checklist

Project Name: New Academic and Laboratory Building--SCSU

Date: 09-24-2012

Sustainable Sites — Possible Points: 26

Y	?	N			
18	6	2			
Y			Prereq 1	Construction Activity Pollution Prevention	
1			Credit 1	Site Selection	1
5			Credit 2	Development Density and Community Connectivity	5
		1	Credit 3	Brownfield Redevelopment	1
6			Credit 4.1	Alternative Transportation—Public Transportation Access	6
1			Credit 4.2	Alternative Transportation—Bicycle Storage and Changing Rooms	1
	3		Credit 4.3	Alternative Transportation—Low-Emitting and Fuel-Efficient Vehicles	3
	2		Credit 4.4	Alternative Transportation—Parking Capacity	2
		1	Credit 5.1	Site Development—Protect or Restore Habitat	1
1			Credit 5.2	Site Development—Maximize Open Space	1
1			Credit 6.1	Stormwater Design—Quantity Control	1
1			Credit 6.2	Stormwater Design—Quality Control	1
1			Credit 7.1	Heat Island Effect—Non-roof	1
1			Credit 7.2	Heat Island Effect—Roof	1
	1		Credit 8	Light Pollution Reduction	1

Water Efficiency — Possible Points: 10

Y	?	N			
2		8			
Y			Prereq 1	Water Use Reduction—20% Reduction	
2		2	Credit 1	Water Efficient Landscaping	2 to 4
		2	Credit 2	Innovative Wastewater Technologies	2
		4	Credit 3	Water Use Reduction	2 to 4

Energy and Atmosphere — Possible Points: 35

Y	?	N			
15	2	18			
Y			Prereq 1	Fundamental Commissioning of Building Energy Systems	
Y			Prereq 2	Minimum Energy Performance	
Y			Prereq 3	Fundamental Refrigerant Management	
8	2	9	Credit 1	Optimize Energy Performance	1 to 19
		7	Credit 2	On-Site Renewable Energy	1 to 7
2			Credit 3	Enhanced Commissioning	2
2			Credit 4	Enhanced Refrigerant Management	2
3			Credit 5	Measurement and Verification	3
		2	Credit 6	Green Power	2

Materials and Resources — Possible Points: 14

Y	?	N			
4	3	7			
Y			Prereq 1	Storage and Collection of Recyclables	
		3	Credit 1.1	Building Reuse—Maintain Existing Walls, Floors, and Roof	1 to 3
		1	Credit 1.2	Building Reuse—Maintain 50% of Interior Non-Structural Elements	1
1	1		Credit 2	Construction Waste Management	1 to 2
		2	Credit 3	Materials Reuse	1 to 2

Materials and Resources, Continued

Y	?	N			
1	1		Credit 4	Recycled Content	1 to 2
1	1		Credit 5	Regional Materials	1 to 2
		1	Credit 6	Rapidly Renewable Materials	1
1			Credit 7	Certified Wood	1

Indoor Environmental Quality — Possible Points: 15

Y	?	N			
9	3	3			
Y			Prereq 1	Minimum Indoor Air Quality Performance	
Y			Prereq 2	Environmental Tobacco Smoke (ETS) Control	
	1		Credit 1	Outdoor Air Delivery Monitoring	1
		1	Credit 2	Increased Ventilation	1
1			Credit 3.1	Construction IAQ Management Plan—During Construction	1
1			Credit 3.2	Construction IAQ Management Plan—Before Occupancy	1
1			Credit 4.1	Low-Emitting Materials—Adhesives and Sealants	1
1			Credit 4.2	Low-Emitting Materials—Paints and Coatings	1
1			Credit 4.3	Low-Emitting Materials—Flooring Systems	1
	1		Credit 4.4	Low-Emitting Materials—Composite Wood and Agrifiber Products	1
1			Credit 5	Indoor Chemical and Pollutant Source Control	1
1			Credit 6.1	Controllability of Systems—Lighting	1
1			Credit 6.2	Controllability of Systems—Thermal Comfort	1
1			Credit 7.1	Thermal Comfort—Design	1
	1		Credit 7.2	Thermal Comfort—Verification	1
		1	Credit 8.1	Daylight and Views—Daylight	1
		1	Credit 8.2	Daylight and Views—Views	1

Innovation and Design Process — Possible Points: 6

Y	?	N			
1	4	1			
	1		Credit 1.1	Exemplary Performance-MRc2 Construction Waste Management	1
	1		Credit 1.2	Innovation in Design: Interactive Educational Displays	1
	1		Credit 1.3	Innovation in Design: Green Housekeeping	1
	1		Credit 1.4	Innovation in Design: Green Furniture	1
		1	Credit 1.5	Innovation in Design: Specific Title	1
1			Credit 2	LEED Accredited Professional	1

Regional Priority Credits — Possible Points: 4

Y	?	N			
3		1			
1			Credit 1.1	Regional Priority: SSc6.1-Stormwater Design Quantity Control	1
1			Credit 1.2	Regional Priority: SSc7.1-Heat Island Effect Non-Roof	1
1			Credit 1.3	Regional Priority: SSc7.2-Heat Island Effect Roof	1
		1	Credit 1.4	Regional Priority: Specific Credit	1

Total — Possible Points: 110

Y	?	N			
52	18	40			

Certified 40 to 49 points Silver 50 to 59 points Gold 60 to 79 points Platinum 80 to 110

MATERIALS CREDITS DOCUMENTATION SHEET

LEED™ - GREEN BUILDING RATING SYSTEM

MATERIAL OR PRODUCT:	
MATERIAL COST (LESS LABOR AND EQUIPMENT):	
Subcontractor/Installer:	Manufacturer:
Address:	Manufacturing Location Address:
Contact:	

Signed by:_____ Date:_____

Company:_____

Instructions to Construction Manager/Subcontractor/Installer: Please complete the following information in all appropriate categories. Use one documentation sheet for each product or material (e.g. tile and grout each get their own sheet). Note as N/A if not applicable. Attach letter of certification from the manufacturer verifying all applicable credits.

LEED SS Credit 7.1 – Heat Island Effect, Non-Roof
Do paving materials have a Solar Reflectance Index of at least 29?

Product Name:	Solar Reflectance Index (SRI):

LEED SS Credit 7.2 – Heat Island Effect, Roof
Do roof materials/products have a high Solar Reflectance Index?

Product Name:	Roof Slope:	Solar Reflectance Index (SRI):

LEED MR Credit 4 - Recycled Content
Does the material/product contain post-consumer and/or pre-consumer content?

Percentage of post-consumer content?	
Percentage of pre-consumer content?	

If only part of the assembly contains recycled content, fill in the detail chart below:

Assembly Components:	Weight (lbs):	% Post-Con *	% Pre-Con *
Totals by Weight (100% of assembly):*			

* Assembly Recycled Content = [Component Weight (lbs) x Recycled Content (%) / Total Weight (lbs)] x 100%.

LEED MR Credit 5 - Regional Materials

Was the material/product manufactured regionally?

Location of Manufacturer (City/State):	
Distance from Manufacturer to Project Site (Miles):	

Does the material/product contain regionally extracted, harvested, or recovered materials?

Raw Materials:	City/State:	Miles to Proj. Site:

If only part of the assembly contains regional material, fill in the detail chart below:

Assembly Components:	Weight (lbs):	% Regional *
Totals by Weight (100% of assembly):*		

* Assembly Regional Material = [Component Weight (lbs) x Regional Material (%) / Total Weight (lbs)] x 100%.

LEED MR Credit 6 – Rapidly Renewable Materials

Does the material/product contain rapidly renewable materials?

Raw Materials:			% of Material

LEED MR Credit 7 – FSC Certified Wood Materials

*Does the product/material contain FSC certified wood?**

Component:	FSC Pure, Mixed Credit, or Mixed __%	Chain of Custody Certificate #	% of Material $

* Attach vendor invoices for each new wood-based component.

LEED IEQ Credit 4.1 – Low-Emitting Materials, Adhesives & Sealants

Does the product/material comply with VOC limits of SCAQMD rules or Green Seal standards?

Product Name:	CRI-ID # if applicable	VOC Content (g/L)

LEED IEQ Credit 4.2 – Low-Emitting Materials, Paints & Coatings

Does the product/material comply with VOC limits of SCAQMD rules or Green Seal Standards?

Product Name:	VOC Content (g/L)

LEED IEQ Credit 4.3 – Low-Emitting Materials, Flooring Systems

Does the carpet material/product meet the Carpet and Rug Institute's Green Label Plus Program?

Carpet Product Name (and backing type):	CRI ID No.

Does the carpet pad material/product meet the Carpet and Rug Institute's Green Label Program?

Pad Product Name:	CRI ID No.

Does the carpet adhesive comply with VOC limits of SCAQMD rules or Green Seal standards?

Product Name:	CRI-ID # if applicable	VOC Content (g/L)

Is the hard surface flooring compliant with the SCS FloorScore standard?

Hard Surface Flooring Product Name:	FS Reg. No.

Does the tile setting and grout product/material comply with VOC limits of SCAQMD rules?

Tile Setting and Grout Product Name:	VOC Content (g/L)

Does the floor coating comply with VOC limits of SCAQMD rules or Green Seal Standards?

Product Name:	VOC Content (g/L)

LEED IEQ Credit 4.4 – Low-Emitting Materials, Composite Wood and Agrifiber Products

Does the product/material contain added urea-formaldehyde resins?

Product Name:	Yes/No	Binder Type

BI-RS-283 New Academic Laboratory Building, SCSU

State of Connecticut
Capital Projects
High Performance Buildings Requirements

Compliance Checklist--State Facilities

Section 16a-38k-3 Mandatory Building Project Requirements for All Buildings

The regulations require the Design Team for New Construction projects covered by 16a-38k-2(a) to include all of the following Twelve (12) Mandatory Requirements in

The Mandatory Requirements are summarized below:

Req. No.	Section	Description	Summary of Requirement	Applicable LEED Prerequisite or Credit (for reference only)
1	16a-38K-3(a)	**Building Commissioning**	Building commissioning process as an integral part of the project.	EAp1, EAc2
2	16a-38K-3(b)	**Integrated Design Process**	Design process to achieve environmental and building performance goals.	Design Team's general approach to LEED certification.
3	16a-38K-3(c)	**Base Energy Performance 21% Better Than Code**	Base minimum energy performance shall be twenty-one (21%) better than the most current Connecticut State Building Code or ASHRAE 90.1-2004.	EAp2, EAc1
4	16a-38K-3(d)	**ENERGY STAR Products**	Energy consuming products shall be ENERGY STAR compliant.	EAp2, EAc1
5	16a-38K-3(e)	**Indoor Air Quality Management Plan (IAQ)**	The project manager-facilitator shall develop a plan for indoor air quality management for the construction phase.	IEQc3.1, IEQc3.2
6	16a-38K-3(f)	**Water Efficiency**	Reduce water usage by 20%.	WEp1
7	16a-38K-3(g)	**Recycling of Materials**	Provide convenient areas to serve as collection points for recyclables. Include an area for sorting and storage.	MRp1
8	16a-38K-3(h)	**Erosion and Sedimentation Control**	Include a plan for erosion and sedimentation control.	SSp1
9	16a-38K-3(i)	**No Smoking Policy**	No smoking shall be permitted in the building.	IEQp2
10	16a-38K-3(j)	**Integrated Pest Management Plan**	Establish an Integrated Pest Management Plan.	N.A.
11	16a-38K-3(k)	**CFC Refrigerant Ban or Phase-out Plan**	CFC-based refrigerants shall not be used for energy systems.	EAp3
12	16a-38K-3(l)	**Minimum Ventilation Requirements**	Design the building with a minimum ventilation requirement meeting ASHRAE 62.1 or Connecticut State Building Code.	IEQp1

Section 16a-38k-4: Building Standard Strategies for State Facilities

All building projects as defined in sections 16a-38k-2 (a) and 16a-38k-2 (b) of the Regulations of Connecticut State Agencies shall implement a minimum of twenty-six of the sixty strategies in subsections (a) through (f) of section 16a-38k-4.

See below for compliance alternative to this requirement used by this project.

Section 16a-38k-7: Alternative Strategies to Section 16a-38k-4 Regulation Compliance Alternative for Building Standard Options

As an alternative to meeting the criteria in section 16a-38k-4 of the Regulations of Connecticut State Agencies, this project will meet the requirements of section 16a-38k-4 by receiving a Leadership in Energy and Environmental Design (LEED) Silver label certification from the U.S. Green Building Council.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Construction Documents and general provisions of the CMR Agreement Between Owner and Construction Manager and the Guaranteed Maximum Price (GMP) Amendment, including Division 00 General Conditions of the Contract for Construction – CMR and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes equipment and system commissioning, including the following:

1. Completion of commissioning procedures on specific equipment and systems as indicated under "Related Sections" below.
2. Verification of operational and functional performance of specific equipment and systems for compliance with the “Design Intent” as described in the "Related Sections" indicated below.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Section 01 31 00 Project Management And Coordination - CMR specifies procedures for coordinating the Commissioning Process.
2. Division 01 Section 01 33 00 "Submittal Procedures - CMR" specifies procedures for submittal of Product Data and Quality Assurance Submittals.
3. Division 01 Section 01 77 00 "Closeout Procedures- CMR" specifies general closeout requirements.
4. Division 21 Section 21 08 00 "Commissioning of Fire Suppression" specifies closeout and/or commissioning related requirements for specific pieces of equipment or building operating systems.
5. Division 22 Section 22 08 00 "Commissioning of Plumbing" specifies closeout and/or commissioning related requirements for specific pieces of equipment or building operating systems.
6. Division 23 Section 23 08 00 "Commissioning of HVAC" specifies closeout and/or commissioning related requirements for specific pieces of equipment or building operating systems.
7. Division 23 Section 23 08 00 "Commissioning of HVAC" specifies closeout and/or commissioning related requirements for specific pieces of equipment or building operating systems.
8. Division 25 Section 25 08 00 "Commissioning of Integrated Automation” specifies closeout and/or commissioning related requirements for specific pieces of equipment or building operating systems.
9. Division 26 Section 26 08 00 "Commissioning of Electrical Systems" specifies closeout and/or commissioning related requirements for specific pieces of equipment or building operating systems.
10. Division 27 Section 27 08 00 "Commissioning of Communications" specifies closeout and/or commissioning related requirements for specific pieces of equipment or building operating systems.

1.3 DEFINITIONS

A. Basis of Design (BOD): A document that records the concepts, calculations, decisions, and product selections used to meet the Owner’s Project Requirements and to satisfy

applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.

B. Commissioning Agent (CxA): An entity identified by the Owner who leads, plans, schedules, and coordinates the commissioning team to implement the Commissioning Process.

C. Commissioning (Cx) Plan: A plan that includes a list of all equipment to be commissioned, delineation of roles for each of the primary commissioning participants, and details on the scope, timeline, and deliverables throughout the commissioning process."

C. Deficiencies and Resolutions List: List of noted deficiencies discovered as result of commissioning process.

E. Final Commissioning Report: Overall final commissioning document (see 1.6, I(2) below), prepared by the Commissioning Agent, which details the actual commissioning procedures performed, inspection and testing results, and the final version of the deficiencies and resolutions list indicating that all issues discovered through the commissioning process have been verified as resolved.

F. Functional Completion: Functional Completion is when all remaining TAB (Testing, Adjusting, Balancing) and commissioning responsibilities of the CMR and their subcontractor's (except for seasonal or approved deferred testing and controls training), have been functionally certified as complete by the Owner's Commissioning Authority (CxA) and the Certificate of Functional Completion has been issued.

G. Functional Performance Testing Process: Documented testing of system parameters, under actual or simulated operating conditions. Functional testing is the dynamic testing of systems (rather than just components).

H. Pre-Commissioning Checklists: Installation and start-up items to be completed by the appropriate party prior to operational verification through Functional Testing.

I. Physical Inspection Process: On-site inspection and review of related system components for conformance to the specifications.

J. Seasonal Commissioning Tests: Functional Tests that are deferred until the system(s) will experience conditions closer to their intended design conditions.

K. Trending: Monitoring using the building control system.

1.4 COORDINATION

A. Commissioning Team: The members of the commissioning team consist of the Commissioning Agent (CxA), the CTDCS Project Manager (CTDCS PM), the Owner's Representative (OR), Construction Manager at Risk (CMR), the Architect and Design Engineers (particularly the Mechanical Engineer), the Mechanical Subcontractor, the Electrical Subcontractor, the TAB representative, the Controls Subcontractor, any other installing subcontractors or suppliers of equipment. If known, the Agency's building or plant operator/engineer is also a member of the Commissioning team.

B. Management: The CxA is hired by the Owner. The CxA directs and coordinates the commissioning activities and the reports to the OR. All members of the Commissioning Team work together to fulfill their contracted responsibilities and meet the objectives of the Contract Documents. Refer to Section 01 91 00 Part 1.6 and 1.7 for additional management details.

C. Scheduling. The CxA will work with the OR and CMR according to established protocols to schedule the commissioning activities. The CxA will provide sufficient notice to the OR and CMR for scheduling commissioning activities. The CMR will integrate all commissioning activities into their master CPM schedule. All parties will address scheduling problems and make necessary notifications in a timely manner in order to expedite the commissioning process.

1. The CxA will provide the initial schedule of primary commissioning events at the commissioning scoping meeting. The Commissioning Plan—Construction Phase provides a format for this schedule. As construction progresses more detailed schedules are developed by the CxA. The Commissioning Plan also provides a format for detailed schedules.

1.5 DESCRIPTION OF CONSTRUCTION PHASE COMMISSIONING PROCESS

A. As soon as practicable after the "Contract Start Date" the Commissioning Agent (CxA) will conduct a pre-installation commissioning "kick-off" meeting with the Construction Manager's subcontractors. Parties directly affected by the commissioning work will be required to attend. The CxA will explain the commissioning process in detail, and identify specific commissioning related responsibilities of the various parties.

B. Commissioning status meetings will be scheduled to occur during construction to monitor progress and to help facilitate the commissioning process. Construction Manager's subcontractor's representatives will be required to attend these meetings.

C. Once Construction Manager's subcontractors have provided the CxA with written verification indicating completion of installation and startup procedures, the CxA will conduct an on-site physical inspection of the specific systems and equipment.

D. Upon confirmation of system readiness, the CxA will schedule with the Construction Manager's subcontractors to perform functional compliance with the project specifications and drawings. The CxA will oversee the process and will provide the format and documentation for these tests.

E. Deficiencies noted during these tests will be documented on the Deficiencies and Resolutions list. When corrected, issues will be resolved at the time of discovery. The responsible Construction Manager's subcontractor will resolve all other issues at a later date. All deficiencies will be noted by the CxA as either resolved or pending resolution.

F. The construction commissioning process will be complete when all noted deficiencies have been corrected, proved to be compliance with the project specifications or otherwise resolved to the satisfaction of the Owner and when the CxA has issued the Certificate of Functional Completion

1.6 COMMISSIONING AGENT'S DUTIES AND RESPONSIBILITIES

A. Meet and communicate with the Construction Manager, Owner's Representative, subcontractors, equipment manufacturers' representatives, Architect, Engineer and others as needed, to facilitate the commissioning process.

B. Review commissioning related specifications, submittals and construction documents. Communicate noted deficiencies and concerns to the Owner, Architect and Engineer.

C. Develop detailed and specific Functional Testing procedures for equipment and systems to be commissioned.

D. Develop testing, adjusting and balancing (TAB) specifications. Oversee the TAB process.

E. Perform site inspections and verify Construction Manager's subcontractor readiness for the Functional Testing process. Document deficiencies for future resolution.

F. Witness Construction Manager's subcontractor performed Functional Testing process as appropriate to verify Construction Manager's subcontractor compliance with the functional testing procedures. Document deficiencies for future resolution.

G. Provide the Construction Manager, Owner's Representative, Architect, and Engineer with a Final Commissioning Report to document the commissioning process and to verify that the commissioning process is complete.

H. Verify that CMR O&M documentation is complete.

I. Commissioning Record in O&M Manuals.

1. The CxA is responsible to compile, organize and index the following commissioning data by equipment into labeled, indexed and tabbed, three-ring binders and deliver it to the CMR, to be included with the O&M manuals. Three copies of the manuals will be provided. The format of the manuals shall be:

1.1 Tab I-1: Commissioning Plan;

1.2 Tab I-2: Final Commissioning Report (see (2) below)

1.3 Tab 01: System Type 1 (chiller system, packaged unit, boiler system, etc.);

1.3.1 Sub-Tab A: Design narrative and criteria, sequences, approvals for equipment in System Type 1;

1.3.2 Sub-Tab B: Startup plan and report, approvals, corrections, blank Precommissioning Checklists;

.1 Colored Separator Sheets—for each equipment type (fans, pumps, chiller, etc.);

1.3.3 Sub-Tab C: Functional tests (completed), trending and analysis, approvals and corrections, training plan, record and approvals, blank functional test forms and a recommended recommissioning schedule.

1.4 Tab 02: System Type 2.....repeat as per above requirements for System 1.

2. Final Report Commissioning Report Details. The final commissioning report shall include an executive summary, list of participants and roles, brief building description, overview of commissioning and testing scope and a general description of testing and verification methods. For each piece of commissioned equipment, the report should contain the disposition of the commissioning authority regarding the adequacy of the equipment, documentation and training meeting the contract documents in the following areas:

2.1 Equipment meeting the equipment specifications;

2.2 Equipment installation,

2.3 Functional performance and efficiency;

2.4 Equipment documentation and design intent; and

2.5 Operator training. All outstanding non-compliance items shall be specifically listed. Recommendations for improvement to equipment or operations, future actions, commissioning process changes, etc. shall also be listed. Each non-compliance issue shall be referenced to the specific functional test, inspection, trend log, etc. where the deficiency is documented. The functional performance and efficiency section for each piece of equipment shall include a brief description of the verification method used (manual testing, BAS trend logs, data loggers, etc.) and include observations and conclusions from the testing.

2.6 Pre-Occupancy Commissioning (Cx) Report:
A Pre-occupancy Commissioning (Cx) Report shall be prepared by the Commissioning Agent (CxA) that demonstrates that the project has met all of the requirements spelled out in the following Table:

Twelve (12) Mandatory Requirements [16a-38k-3] Summary Table:		
	Regulation	Summary Description
1.	16a-38k-3(a)	Building Commissioning:
2.	16a-38 -3(b)	Integrated Design Process:
3.	16a-38k-3(d)	ENERGY STAR Products:
4.	16a-38k-3(c)	Energy Performance:

5.	16a-38k-3(e)	Indoor Air Quality Management Plan:
6.	16a-38k-3(f)	Water Usage:
7.	16a-38k-3(g)	Recycling of Materials:
8.	16a-38k-3(h)	Erosion and Sedimentation Control:
9.	16a-38k-3(i)	No Smoking Policy:
10.	16a-38k-3(j)	Integrated Pest Management Plan:
11.	16a-38k-3(k)	Chlorofluorocarbon (CFC)-Based Refrigerants:
12.	16a-38k-3(l)	Minimum Ventilation Requirement:

2.7 Post-Occupancy Commissioning (Cx) Report:
A Post-Occupancy Commissioning (Cx) Report shall be prepared by the Commissioning Agent (CxA) and [submitted to the CTDPW PM for review and approval. The approved Report shall be submitted by the State Agency that is responsible for the ongoing care, operation, and maintenance of the building to the CT OPM Secretary and the CT DPW Commissioner within one hundred eighty (180) days after one year of occupancy Date of CTDPW Acceptance of the Work. The Report shall include results of any post-occupancy survey of building occupants, a description of any adjustments made to equipment or building operation and the reasons for which the changes were made, and one year of all energy usage by source and water usage.

3. Other documentation will be retained by the CxA.

1.7 DUTIES AND RESPONSIBILITIES OF OTHERS FOR COMMISSIONING

A. The commissioning process will require the active participation of persons qualified to represent the Owner, Mechanical Engineer, Electrical Engineer, Construction Manager, Equipment Manufacturers' Representatives, Mechanical Subcontractor, HVAC Subcontractor, Controls Subcontractor, TAB Subcontractor, Electrical Subcontractor, and other specific subcontractors, as deemed appropriate. The CxA will witness the final functional performance commissioning process. Participants shall include in their contracts all costs necessary to participate in and complete the commissioning process.

B. The Construction Manager will assure the participation and co-operation of the subcontractors, as required to complete the commissioning process.

C. The Owner will assure the participation of their chosen representatives as required to complete the commissioning process.

D. The Architect will assure the participation of necessary representatives from the Design Team as required to complete the commissioning process. Design team members will provide prompt replies to requests for information issued during the commissioning process.

E. It is the Construction Manager's specific responsibility to complete their respective start-up and checkout procedures, and to insure the complete readiness of equipment and systems, prior to the start of the functional performance testing phase. The CxA shall request written confirmation of system readiness for performance testing, from the appropriate Construction Manager's subcontractor. Once the CxA is provided with confirmation of all related systems completion, the actual date and times for the functional performance testing process will be confirmed. Construction Manager's subcontractor shall provide sufficient time, and qualified representatives, to complete this process at no additional cost to the State.

F. After a second failure of a system to successfully meet the criteria as set forth in the functional performance testing process, the Construction Manager shall reimburse the Owner

for all costs associated with any additional re-testing efforts made necessary due to remaining Construction Manager related system deficiencies previously reported by the Construction Manager as corrected. These costs shall also include the costs (where applicable) for the CxA.

G. Training on related systems and equipment operation and maintenance shall only be scheduled to commence after final performance commissioning is satisfactorily completed, and systems are verified to be 100 percent complete and functional.

1.8 SUBMITTALS

A. Refer to Section 01 33 00 Submittal Procedures - CMR.

B. Pre-Commissioning Checklist Forms: Submit [two (2)] signed copies of the checklist forms to the CxA upon completion of all listed items.

C. Equipment Manufacturer's Startup Forms: Submit [two (2)] completed copies of the installation and startup checklists provided by the equipment manufacturers to the CxA.

D. Test Reports: Submit [two (2)] copies of test reports for equipment and systems to the CxA.

E. Control Schematics: Submit [two (2)] copies of the control schematics for equipment, systems, and subsystems to the CxA.

F. Inspection Records: Submit [two (2)] copies of the records of inspections for code compliance, and approved permits and licenses to operate the equipment and systems to the CxA.

G. Operating Data: Submit [two (2)] copies of equipment and system operating data including all necessary instructions to facilitate operation to specified performance standards to the Owner.

H. Maintenance Data: Submit [two (2)] copies of equipment and system maintenance data including all necessary information required to maintain the equipment and systems in continuous operation, such as the testing, balancing and adjusting report and the as-built drawings.

1.9 TRAINING OF OWNER PERSONNEL

A. The CMR shall be responsible for training coordination and scheduling and ultimately for ensuring that training is completed.

B. The CxA shall be responsible for overseeing and approving the content and adequacy of the training of Agency's personnel for commissioned equipment.

1. The CxA shall interview the Agency's facility manager and lead engineer to determine the special needs and areas where training will be most valuable. The Owner's Representative, Agency's facility manager, and CxA shall decide how rigorous the training should be for each piece of commissioned equipment. The CxA shall communicate the results to the CMR of Subs and vendors who have training responsibilities.

2. In addition to these general requirements, the specific training requirements of Owner personnel by Subcontractor and vendors are specified in Divisions 21, 22, 23, 25, 26, and 27.

3. The CMR shall require each Subcontractor and vendor responsible for training to submit a written training plan to the CxA for review and approval prior to training. The plan will cover the following elements:
   3.1 Equipment (included in training)
   3.2 Intended audience;
   3.3 Location of training;
   3.4 Objectives;
   3.5 Subjects covered (description, duration of discussion, special methods, etc.);

3.6 Duration of training on each subject
3.7 Instructor for each subject;
3.8 Methods (classroom lecture, video, site walk-through, actual operational demonstrations, written handouts, etc.)
3.9 Instructor and qualifications;

4. For the primary HVAC equipment, the Controls Contractor shall provide a short discussion of the control of the equipment during the mechanical or electrical training conducted by others.
5. The CxA shall develop an overall training plan and coordinate schedules with the OR, Agency Representative, and CMR for the commissioned systems. The CxA shall develop criteria for determining that the training was satisfactorily completed, including attending some of the training, etc. The CxA shall recommend approval of the training to the OR using a standard form for submittal to the CMR. The OR will sign the approval form.
6. At one of the training sessions, the CxA shall present a one (1) hour presentation discussing the use of the blank functional test forms for re-commissioning equipment.
7. Video recording of the training sessions shall be provided by CMR. The CMR shall provide the OR, with video disks cataloged by CMR, and added to the O&M manuals.
8. The HVAC design engineer shall at the first training session present the overall system design concept and the design concept of each equipment section. This presentation shall be two (2) hours in length and include a review of all systems using the simplified system schematics (one-line drawings) including chilled water systems, condenser water or heat rejection systems, heating systems, fuel oil and gas supply systems, supply air systems, exhaust system and outside air strategies.

1.10 DEFERRED TESTING

A. Unforeseen Deferred Tests. If the CMR determines that any check or test cannot be completed due to the building structure, required occupancy condition or other deficiency, execution of checklists and Functional Testing may be delayed upon approval of the CTDPW PM. These tests will be conducted in the same manner as the seasonal tests as soon as possible. Services of necessary parties will be negotiated.

B. Seasonal Testing. During the warranty period, seasonal testing (tests delayed until weather conditions are closer to the system's design intent) as specified in Division 23 shall be completed as part of this contract. The CxA shall coordinate this activity. Tests shall be executed, documented and deficiencies corrected by the appropriate CMR's Subcontractors, with the Agency facilities staff and the CxA witnessing. Any final adjustments to the O&M Manuals and As-Built Drawings due to the testing, shall be made by the Contractor.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01 91 00 - CMR

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

1.2 SUBSURFACE INVESTIGATION

A. Information Not Guaranteed: Information on the Drawings and in the Project Manual relating to subsurface conditions, natural phenomena, and existing utilities and structures is from the best sources presently available. Such information is furnished only for the information and convenience of the Contractor, and the accuracy or completeness of this information is not guaranteed.

B. Foundation Engineering Report: Refer to the Geotechnical Report in the Appendices.

1.3 CONFIRMATION OF GRADES AND UTILITIES

A. Prior to commencement of site excavating operations, the Contractor shall compare existing site grading and proposed new site grading. Where existing utilities are indicated but their inverts or depths are not, exploratory excavating shall be performed to assure that sufficient earth coverage will be attained during the course of new site grading.

1. Utilities existing on the site shall be carefully protected from damage and relocated or removed as required by the work. When an active utility line is exposed during construction, its location and elevation shall be plotted on the record drawings and the Architect, Owner and the utility owner notified in writing.

B. If exploratory excavating confirms that the depth of existing utilities will be negatively impacted by proposed new grades (i.e., will be too shallow or become exposed), immediately notify the Architect and the Owner. Do not proceed with work in such areas until instructions are issued by the Architect. Continue work in other areas.

1.4 CONFIRMATION OF INTEGRITY OF ADJACENT STRUCTURES

A. Prior to commencement of site excavating operations, the Contractor shall compare foundation depths of existing structures and proposed depths of new utilities. Where existing structures are indicated but their foundation depths are not, exploratory excavating shall be performed to assure that proposed new excavations adjacent to them, or in near proximity of them, will not undermine the structural integrity of the existing structures.

B. If exploratory excavating confirms that the footing depths of existing structures may be negatively impacted or undermined by proposed new excavations, immediately notify the Architect and the Owner. Do not proceed with work in such areas until instructions are issued by the Architect. Continue work in other areas.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

END OF SECTION 02 30 00

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included:

1. Demolition and removal of selected portions of buildings and structures and as required for new work. Demolition of designated exterior and interior building structures and finishes; includes connector/bridge to existing Jennings Hall at basement and Third Floor levels. Refer to the Drawings for additional requirements.
2. Demolition and removal of selected site elements and as required for new work. Refer to the Drawings for additional requirements.
3. Removal and legal disposal of demolished materials off site. Except those items specifically designated to be relocated, reused, or turned over to the facility, all existing removed materials, items, trash and debris shall become property of the Contractor and shall be completely removed from the site and legally disposed of at her/his expense. Salvage value belongs to the Contractor. On-site sale of materials is not permitted.
4. Maintenance, watering and care of trees designated to remain by a certified arborist during the construction period.
5. Demolition and removal work shall properly prepare for alteration work and new construction to be provided under the Contract.
6. Scheduling and sequencing operations without interruption to utilities serving occupied areas. If interruption is required, obtain written permission from the utility company and the Owner. Provide temporary services as necessary to serve occupied and usable facilities when permanent utilities must be interrupted, or schedule interruption when the least amount of inconvenience will result.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 01 50 00 - TEMPORARY FACILITIES AND CONTROLS:
   a. Maintenance of access, cleaning during construction, dust and noise control.
2. Section 01 74 19 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL:
   a. Waste management and recycling.

1.3 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Salvage: Detach items from existing construction and deliver them to the Owner ready for reuse, at a location designated by the Owner. Protect from weather until accepted by Owner.

C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated. Protect from weather until reinstallation.

D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 MATERIALS OWNERSHIP

A. Historic items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques, antiques, and other items of interest or value to Owner that may be encountered during selective demolition remain property of the Owner as applicable. Carefully remove each item or object in a manner to prevent damage and deliver promptly to a location acceptable to the Owner.

1.5 SUBMITTALS

A. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with early and late starting and finishing dates for each activity. Ensure Owner's on-site operations are uninterrupted if applicable.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Use of elevator and stairs.
5. Locations of proposed dust- and noise-control temporary partitions and means of egress, including for other occupants affected by selective demolition operations.
6. Coordination of Owner's continuing occupancy of portions of existing building and of Owner’s partial occupancy of completed Work.
7. Means of protection for items to remain and items in path of waste removal from building.

B. Inventory: After selective demolition is complete, submit a list of items that have been removed and salvaged, and turned over the Owner.

C. Predemolition Videotapes: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by selective demolition operations. Comply with Division 01. Submit before Work begins.

D. Landfill Records: Provide trip tickets (receipts) indicating receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1. Comply with submittal requirements in Section 01 74 19 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL.

1.6 QUALITY ASSURANCE

A. Examination of Existing Conditions: The Contractor shall examine the Contract Drawings for demolition and removal requirements and provisions for new work. Verify all existing conditions and dimensions before commencing work. The Contractor shall visit the site and examine the

existing conditions as he finds them and shall inform herself/himself of the character, extent and type of demolition and removal work to be performed. Submit any questions regarding the extent and character of the demolition and removal work in the manner and within the time period established for receipt of such questions during the bidding period.

B. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.

C. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

D. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

E. Standards: Comply with ANSI A10.6 and NFPA 241.

F. Predemolition Conference: Conduct conference at Project site to comply with requirements in Section 01 31 19 - PROJECT MEETINGS. Review methods and procedures related to selective demolition including, but not limited to, the following:

1. Inspect and discuss condition of construction to be selectively demolished.
2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.

1.7 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped.

B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.

D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.

E. Engage a professional engineer registered in the state that the project is located to survey condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective demolition operations.

F. Survey of Existing Conditions: Record existing conditions by use of preconstruction videotapes.

1. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

G. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Service/System Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Arrange to shut off indicated utilities with utility companies and Owner.
2. If services/systems are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
3. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing. Where entire wall is to be removed, existing services/systems may be removed with removal of the wall.
4. Prior to commencing cutting work in existing surfaces, take all precautionary measures to assure that mechanical and electrical services to the particular area have been made inactive. Coordinate with Fire Protection, Plumbing, HVAC, and Electrical subcontractors. Only licensed tradesmen of that particular trade shall disconnect and cap existing mechanical and electrical items that are to be removed, abandoned and/or relocated.
5. If, during the process of cutting work, existing utility lines are encountered which are not indicated on the Drawings, regardless of their condition, immediately report such items to the Architect. Do not proceed with work in such areas until instructions are issued by the Architect. Continue work in other areas.

3.3 PREPARATION

A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Comply with requirements for access and protection specified in Section 01 50 00 - TEMPORARY FACILITIES AND CONTROLS.
2. Maintain adequate passage to and from all exits at all times. Before any work is done which significantly alters access or egress patterns, consult with the Architect and obtain

approval of code required egress. Under no condition block or interfere with the free flow of people at legally required exits, or in any way alter the required condition of such exits.

B. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of selective demolition.
2. Remove temporary shoring, bracing and structural supports when no longer required.
3. Post warning signs and place barricades as applicable during placement and removal of temporary shoring.

C. Conduct demolition operations to prevent injury to people and damage to adjacent buildings and facilities to remain. Ensure safe passage of people around demolition area(s).

1. Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction. Provide temporary barricades as required to limit access to demolition areas.
2. Protect existing site improvements, appurtenances, and landscaping to remain.

D. Drain, purge, or otherwise remove, collect, and dispose of chemicals, gases, explosives, acids, flammables, or other dangerous materials before proceeding with demolition operations.

3.4 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
5. Maintain adequate ventilation when using cutting torches.
6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

9. Dispose of demolished items and materials promptly. Comply with requirements in Section 01 74 19 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL.

B. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

C. Items for Re-use and Preservation of Existing Surfaces to Remain:

1. The Contractor shall inspect closely each item specifically designated to be relocated, re-used, or turned over to the Owner prior to its removal, and immediately report damages and defects to the Architect and the Owner. The Contractor shall be responsible for any subsequent damage to the same other than latent defects not readily apparent from close inspection, and shall bear responsibility for its repair or same replacement as directed by the Architect, to the satisfaction of the Owner.
2. Unless special surface preparation is specified under other Specification Sections, leave existing surfaces that are to remain in a condition suitable to receive new materials and/or finishes.

3.5 PROTECTION OF PUBLIC AND PROPERTY

A. Provide all measures required by federal, state and municipal laws, regulations, and ordinances for the protection of surrounding property, the public, workmen, and Owner's employees during all demolition and removal operations. Measures are to be taken, but not limited to installation of sidewalks, sheds, barricades, fences, warning lights and signs, trash chutes and temporary lighting.

B. Protect all walks, roads, streets, curbs, pavements, trees and plantings, on and off premises, and bear all costs for correcting such damage as directed by the Architect, and to the satisfaction of the Owner.

C. Demolition shall be performed in such a manner that will insure the safety of adjacent property. Protect adjacent property from damage and protect persons occupying adjacent property from injuries which might occur from falling debris or other cause and so as not to cause interference with the use of other portions of the building, of adjacent buildings or the free access and safe passage to and from the same.

D. Every precaution shall be taken to protect against movement or settlement of the building, of adjacent buildings, sidewalks, roads, streets, curbs and pavements. Provide and place at the Contractor's own expense, all necessary bracing and shoring in connection with demolition and removal work.

E. Remove portions of structures with care by using tools and methods that will not transfer heavy shocks to existing and adjacent building structures, both internal and external of the particular work area.

F. Provide and maintain in proper condition, suitable fire resistive dust barriers around areas where interior demolition and removal work is in progress. Dust barriers shall prevent the dust migration to adjacent areas. Remove dust barriers upon completion of major demolition and removal in the particular work area.

3.6 DISCOVERY OF HAZARDOUS MATERIALS

A. If hazardous materials, such as chemicals, asbestos-containing materials, or other hazardous materials are discovered during the course of the work, cease work in affected area only and immediately notify the Architect and the Owner of such discovery. Do not proceed with work in such areas until instructions are issued by the Architect. Continue work in other areas.

B. If unmarked containers are discovered during the course of the work, cease work in the affected area only and immediately notify the Architect and the Owner of such discovery. Do not proceed with work in such areas until instructions are issued by the Architect. Take immediate precautions to prohibit endangering the containers integrity. Continue work in other areas.

3.7 CUTTING

A. Perform all cutting of existing surfaces in a manner which will ensure a minimal difference between the cut area and new materials when patched. Use extreme care when cutting existing surfaces containing concealed utility lines which are indicated to remain and bear full responsibility for repairing or replacement of all such utilities that are accidentally damaged.

B. Provide a flush saw cut edge where pavement, curb and concrete removals abut new construction work or existing surfaces to remain undisturbed.

3.8 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Comply with requirements of Section 01 74 19 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL and the following.

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

B. Burning: Do not burn demolished materials.

3.9 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Premises shall be left in a clean condition and ready to accept alteration work and new construction.

END OF SECTION 02 41 00

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Refer to Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections that apply to this Section, and are hereby made a part of the Specifications.

B. Examine all Drawings and all other Sections of the Specifications for requirements therein affecting the work of this Section.

C. Coordinate work with that of all other trades affecting or affected by the Work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.

1.2 DESCRIPTION OF WORK

A. This Section provides procedures and requirements for management of excavated soils and materials. Material classification; stockpiling; off-site transportation; off-site reuse, recycling, treatment, and disposal; measures to control dust, odors, and gases; and contingencies are also included. The following Work shall be undertaken by the Contractor:

1. On-site processing and on-site reuse of excavated soils in accordance with the criteria contained herein and all applicable state and federal laws and regulations.
2. Excavate, handle, re-handle, load, and transport soils and materials from the site to legal off-site disposition facilities (reuse, recycling, treatment, and disposal facilities) in accordance with the criteria contained herein and all applicable state and federal laws and regulations.
3. Temporarily stockpile soils that have not been precharacterized, appear inconsistent with precharacterization data based on visual or olfactory evidence of contamination, require additional chemical testing, or are approved for reuse on-site in accordance with the requirements contained herein, and in Section 31 23 00.
4. Determine the destination facility using the chemical test data provided and contract for off-site reuse, recycling, treatment, and disposal directly with each facility proposed by the Contractor and approved by the Owner. The Contractor shall complete all paperwork necessary to transport excavated soils and materials from the site to approved off-site facilities as specified herein. For Group I facilities as defined herein other than regulated landfills, the Contractor shall determine if local municipal ordinances require filing of applications for any permits relative to reuse, stockpiling, or transport of soils within the municipality of the receiving site. The Contractor shall incorporate the time to file and obtain such permits in the planning and execution of its work. The Contractor shall obtain the permit unless otherwise indicated.
5. Arrange for, as necessary, additional chemical testing required by the Contractor-proposed off-site receiving facilities. The Contractor shall coordinate with its proposed off-site receiving facilities and the Owner (and incorporate into the project sequence and schedule) additional chemical testing that may be required prior to and/or during construction, and the times required for additional sampling, laboratory testing, and data review by the Contractor's proposed off-site receiving facilities. Additional testing requested by the Contractor's proposed receiving facilities shall be performed by the Owner. The Contractor shall provide the equipment to obtain the additional samples at no additional cost to the Owner.
6. Prepare and implement an OSHA-compliant site-specific Health and Safety Plan (H&SP) to protect the health and safety of all workers (including subcontractors) engaged in activities where exposure to contaminated soil or groundwater is possible as determined

by a Qualified Health Professional (QHP) retained by the Contractor. The H&SP shall also be designed to protect the general public and the environment during the course of the Work.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 018113, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. Section 02 30 00 – Subsurface Investigation

B. Section 02 41 00 – Demolition

C. Section 31 10 00 – Site Clearing

D. Section 31 20 00 – Earthwork (Utilities)

E. Section 31 20 00.03 – Earth Moving for Site Improvements

F. Section 31 23 00 – Earthwork (Building Area)

1.4 DEFINITIONS AND REFERENCE STANDARDS

A. Owner: Southern Connecticut State University

B. Owner's Representative: State of Connecticut Department of Construction Services (formerly known as the State of Connecticut Department of Public Works)

C. Architect: Centerbrook Architects and Planners, LLP

D. Environmental Consultant: Authorized representative of the Owner. For the work covered under this section, this term shall include Haley & Aldrich, Inc.

E. Contractor: Entity responsible for completing the work of this Section.

F. CTDEEP: Connecticut Department of Energy & Environmental Protection (formerly known as the Connecticut Department of Environmental Protection [CTDEP])

G. MADEP: Massachusetts Department of Environmental Protection

H. EPA: U.S. Environmental Protection Agency

I. RSR: CTDEEP Remediation Standard Regulations

J. MCP: MADEP Massachusetts Contingency Plan

K. OSHA: Occupational Safety and Health Administration

L. PID: Photoionization detector

M. PMC: Pollutant Mobility Criteria

N. RDEC: Residential Direct Exposure Criteria

O. RSVC: Residential Soil Vapor Criteria

P. CMR: Code of Massachusetts Regulations

Q. QHP: Qualified Health Professional. A person retained by the Contractor to prepare the Contractor's Health and Safety Plan (H&SP) and for quality control as specified herein. The QHP shall have a minimum of five years experience in this work, certification as a safety professional qualified by training and experience to act in this capacity, and certification as having completed the 40 hr. OSHA health and safety training course, with current 8-hr. refresher training and 8-hr. OSHA manager's training. The QHP may assume the role of Site Health and Safety Officer.

R. Site Health and Safety Officer (SHSO): (may be the same as the QHP) A person retained by the Contractor to perform field testing for evaluation of environmental contaminants and compounds of concern in air, soil, and groundwater in accordance with the Contractor's H&SP and as directed by the QHP.

S. Polluted Soil: Soil affected by a release of a regulated substance at a concentration above the analytical detection limit for such substance but below applicable RSR criteria.

T. Polluted Fill: Soil or sediment which contained polluting substances at the time such soil or sediment was deposited as fill material.

U. Underground Storage Tank (UST): UST and associated underground piping.

1.5 QUALITY CONTROL AND ASSURANCE

A. The Environmental Consultant will monitor the Contractor’s activities associated with the Work of this Section. This monitoring will include, but not be limited to:

1. Observing and screening excavated soils with a PID as necessary to confirm that their quality is consistent with the findings of the precharacterization programs referenced herein;
2. Establishing requirements for stockpiling, segregating, and handling if the quality of the excavated soils is not consistent with the findings of the precharacterization programs;
3. Reviewing requests from Contractor-proposed off-site reuse, recycling, treatment, and disposal facilities for additional chemical testing;
4. Confirming that the Contractor supplies the appropriate paperwork to accompany each load of excavated soil and material that is transported from the site (at the time the load leaves the site); and
5. Confirming that on-site reuse of materials is conducted in accordance with the precharacterization programs and this Section.

B. The Contractor shall be solely responsible for exercising reasonable precaution to protect the health and safety of all on-site personnel, the general public, and the environment during the course of the Work.

C. The Contractor shall adhere to the applicable requirements of the Standard Specifications, occupational health and safety statutes and codes, and to all other applicable ordinances, codes, statutory rules, and regulations of federal, state, and local authorities having jurisdiction over the Work of this Section and other applicable Sections.

D. In case of conflict between regulations or between regulations and Specifications or between Specifications, the Contractor shall comply with the strictest applicable codes, regulations, or Specifications.

E. The Contractor is required to notify all workers of the history of the site and contaminants that may be present, and to be alert for evidence of contaminated soils and groundwater. The Contractor shall notify the Environmental Consultant of the presence of potentially hazardous conditions immediately, if encountered.

F. The Contractor shall not undertake any Work until the Owner has approved the Contractor's Health and Safety Plan.

1.6 AVAILABLE INFORMATION

A. Preliminary and final soil and groundwater precharacterization programs were conducted for the New Academic Laboratory Building to obtain chemical test data for management of excavated soils and groundwater. The results of these programs are contained in the document entitled "Report on Final Precharacterization Investigation, Proposed Academic Laboratory Building, Southern Connecticut State University, New Haven, Connecticut", prepared by Haley & Aldrich, Inc., dated 23 October 2012 (Precharacterization Report). The Contractor shall as part of its Base Bid coordinate, schedule and implement its work accordingly so as to prevent delays in the project.

B. The chemical test data in the Precharacterization Report will be used for off-site disposition and, as applicable, on-site reuse of soils and groundwater excavated for construction of the building. The Contractor shall review and understand the information contained in this document. The subsurface and environmental conditions information presented in this document, as applicable, are for information only and shall not be interpreted as a warranty of subsurface or environmental conditions whether interpreted from written text, boring logs, chemical test results, or other data.

C. Results of the soil precharacterization data at the New Academic Laboratory Building indicate: 1) site natural soils within the planned excavation area contain compounds at either levels below laboratory reporting limits or levels below comparable CTDEEP RDEC and GA PMC; and 2) an estimated two-thirds of the site fill soils within the planned excavation area contain compounds at levels above comparable CTDEEP RDEC and GB PMC. Soil sample test results were also compared to Massachusetts Department of Environmental Protection (MADEP) landfill reuse criteria. The soil samples met MADEP unlined landfill reuse criteria with the exception of three samples (corresponding to an estimated 250 cu. yd.). These soils should be disposed of via asphalt batching or other forms of recycling.

D. A review of the site history and property uses indicates that the site does not appear to be an Establishment, and is therefore not directly regulated by the CTDEEP RSRs (i.e., the site is not an Establishment, in voluntary remediation, or under a CTDEEP Order). Although the site is not subject to CTDEEP RSRs, specific attention to options for off-site disposition or on-site reuse of these materials may be necessary to comply with CTDEEP policies or other regulatory agency requirements.

E. Management of excavated soils and collected water (from all natural and man-made sources) shall be conducted in accordance with the requirements of this Section, the Precharacterization Report, potential future characterization work, the Contractor's approved H&SP, the State of Connecticut General Permit for the Discharge of Stormwater and Dewatering Wastewaters from Construction Activities (DEP-PERD-GP-015), and all applicable state and federal laws and regulations.

F. No excavated soils or materials shall leave the site without the prior approval of the Owner. Additionally, no soils or materials shall be imported to the site without the prior approval of the Owner.

G. It may be necessary to obtain a Disruption Permit from CTDEEP for managing and disposing of solid waste (e.g., some types of buried demolition debris). The need for this permit is determined by the amount (i.e., greater than 10 cubic yards at any given location) and type of solid waste, and will be assessed during excavation. Based on information obtained to date, it is not anticipated that this permit will be required.

1.7 SUBMITTALS

A. Off-site Reuse, Recycling, Treatment, and Disposal Facilities

1. A minimum of 14 days prior to starting the submittals outlined below and prior to submitting a bid, provide the name, address, telephone number, and contact person for each proposed off-site reuse, recycling, treatment, and disposal facility or location to the Owner for review. This pre-bid submittal is to prescreen the Contractor's proposed off-site receiving facilities prior to the Owner's awarding of the Contract.
2. A minimum of 30 days prior to transport of any soils from the site, submit a letter from each Contractor-proposed receiving facility or location providing all of the information outlined below. The submittal will not be considered complete without all of this information. The Owner will review and approve up to two facilities for each soil group. Additional reviews will be conducted at the Contractor's expense.

B. A statement from the facility indicating that the facility has reviewed the applicable precharacterization data and soil disposal quantity information provided by the Contractor and can legally accept the material. This statement shall also include any contingencies upon which the acceptance is based.

C. A statement from the facility indicating if additional soil quality testing is required to meet the facility's acceptance criteria. If additional testing is required, the facility shall indicate types, numbers, and locations of tests. The Owner will evaluate the requested additional testing and determine the reasonableness of the request. If the Owner considers the request reasonable, the Contractor shall provide the equipment (e.g., excavators and/or drill rigs) to obtain the samples at no additional cost to the Owner, and the Owner will conduct the additional testing.

D. A copy of the facility's permit, consent order(s), and other applicable documentation under which the facility is operating that indicate the facility's testing requirements and acceptance criteria.

E. A statement from the facility indicating the following:

1. That the facility is operating in accordance with its permit, consent order(s), and other applicable documents.
2. If any previous violations or complaints have been filed against the facility; and, if so, provide a brief statement describing the violation(s), how it was addressed, and its current status.
3. Proposed use of soil or material (i.e., reuse, recycle, treatment, disposal, or other) at the facility.
4. Description of facility-mandated quality assurance/quality control chemical sampling (QA/QC) that may be conducted on materials proposed for transport to the facility.
5. Any limitations on soils or materials proposed for transport to the facility based on material consistency (i.e., granular soil, organic soil, or cohesive soil, debris content, slurry excavate, etc.).

6. Whether the facility is an EPA Superfund site or part of one.
7. Remedial treatment systems that are in operation at the facility, if any.
8. If any releases have occurred at or adjacent to the site, if they have been reported to the CTDEEP, MADEP, or other applicable agencies and the status of the release.

F. For Group I facilities as defined herein other than regulated landfills, a statement from the facility and/or the Contractor indicating if local municipal ordinances require filing of applications for any permits relative to reuse, stockpiling, or transport of soils within the municipality of the receiving site.

G. For receiving facilities in Massachusetts, provide facility information necessary to complete Section E of MADEP Bureau of Waste Prevention Material Shipping Record and Log for each facility.

H. For facilities in States other than Massachusetts, provide a trucking manifest acceptable to the Owner unless otherwise directed by the Owner. The manifest shall include the following information, at a minimum:

1. Name and address of the construction site generating the material.
2. Name and address of the receiving facility.
3. Full waste stream description of the material being transported.
4. Truck license plate number.
5. Trailer license plate number.
6. Container number (if applicable).
7. Contractor's name, address, contact person and phone number.
8. Transporter's name, address, contact person and phone number.
9. Printed name and signature of Contractor and date that the load was completed. Printed name and signature of the facility representative and date the load was received at the facility.

I. The Owner will review information submitted by the Contractor as detailed herein. Review of the information may take up to 14 days. The Owner may reject a facility if the submittal process is incomplete, or if the Owner deems the proposed facility unacceptable. Reasons that a facility may be deemed unacceptable include, but are not limited to, the following: if the facility is not operated in accordance with state guidelines or a state granted permit applicable to or issued to the facility, if the facility is or is part of an EPA Superfund Site, if the facility is located on or adjacent to an aquifer or aquifer protection area, if there are unreported or outstanding releases at the site, if previous releases have not been dealt with to the satisfaction of the Owner, if the facility controls for accepting and monitoring waste are not adequate, if existing material at the site does not meet the permit or site guidelines, or any reason that may put the Owner at risk.

J. Once the submittal requirements outlined above are completed to the satisfaction of the Owner, the Owner will prepare a letter of acceptance for signature by the facility, the facility's Environmental Consultant, or other authorized representative of the facility. This letter, once signed and returned to the Owner, will constitute approval of the facility for this project. The Owner will prepare this letter within 7 days of acceptance of the facility. The Owner maintains the right to reject any proposed facility at any time in the review and acceptance process.

1. A minimum of 14 days prior to transport of any soils from the site, provide a letter stating the name and address of the transporter for each material group classification and each off-site facility as applicable. The Owner will prepare trucking manifests (Material Shipping Records or Uniform Hazardous Waste Manifests) for each approved Massachusetts facility within 7 days of approval of the facility. The Contractor shall prepare trucking manifests and/or other required shipping records for approved facilities in states other than Massachusetts.

2. Within 20 days of last shipment, submit copies of completed trucking manifests and Material Shipping Record & Log Forms documenting transport of excavated soils and materials from the site to approved off-site disposal, reuse, recycling, and treatment facilities. The submittal shall also include weight slips for each load transported from the site to the disposal facility.

K. Soil Management Plan

1. Provide a Soil Management Plan describing the schedule, sequence, and procedures for excavation, off-site disposal of soil, on-site reuse of soils, and stockpiling. The narrative shall include description and accompanying scale drawing indicating the space to be used for various activities (e.g., storage for soil, space for removal of debris and conditioning of soil in preparation for reuse, etc.). Narrative shall include schedule and anticipated volume of soil generation for various activities, and schedule and anticipated location for reuse of stockpiled soils.

    a. Excess soils remaining following on-site reuse and excess soils generated during excavation shall be disposed off-site in accordance with the requirements of this Section.
    b. Soils intended to be stockpiled shall be segregated and stockpiled by Group classification (in accordance with this Section) (i.e., a separate stockpile for each soil Group classification).
    c. The Contractor shall bear all additional disposal costs (and related incidental costs) associated with commingling of various soil Groups unless such commingling is directed or approved by the Owner. In the absence of additional chemical test data, commingled soils shall default to the “highest” Group classification of soil in the stockpile with regard to off-site disposal.
    d. If necessary, the Owner will file for and obtain the CTDEEP General Permit for Contaminated Soil and/or Sediment Management (Staging and Transfer), including all costs and fees associated with securing this permit.

2. Upon completion of earthwork activities, the Contractor shall submit a plan drawing documenting locations and depths (in elevation) where the various soil groups are reused on-site and the location and depths of the source material (as applicable). The drawing shall be submitted to the Owner and Environmental Consultant for review.

L. Health and Safety Plan

1. Submit qualifications of the QHP and SHSO. The QHP and SHSO shall have a minimum of five years experience in this work, certification as a safety professional qualified by training and experience to act in this capacity, and certification as having completed the 40 hr. OSHA health and safety training course, with current 8-hr. refresher training and 8-hr. OSHA manager's training. The QHP may assume the role of SHSO.
2. Submit a Health and Safety Plan prepared by the Contractor's QHP. The Health and Safety Plan shall apply to all Work to be conducted at the site, taking into consideration all workers on-site, the general public, and the environment. Training will not be provided by the Owner. The plan shall include the following information:

    a. A list of the Contractor's work tasks that may involve contact, excavation, and/or handling of contaminated soil and/or groundwater.
    b. Compounds of concern that may be encountered during the course of the Work and signs/symptoms of exposure.
    c. Potential for worker exposure to the compounds of concern for each work task.

d. Requirements for OSHA training for each work task and a record or schedule for training of Contractor and subcontractor workers in the use of personal protective equipment.
e. Work task specific levels of protection and a description of health and safety equipment including protective clothing, respiratory equipment and monitoring instruments.
f. Procedures for containing oil and/or hazardous materials such as decontamination of heavy construction equipment and tools.
g. Procedures for monitoring, controlling, and mitigating fugitive dust, odors, and gases for each work task to protect worker and public health and safety, including descriptions of monitoring instruments and action levels triggering responses by the Contractor (e.g., donning personal protective equipment).
h. Emergency Response Plan.

3. The Health and Safety Plan must be completed for discussion at the Health and Safety coordination meeting scheduled by the Contractor and held at least three days prior to commencement of work relating to possible exposure to contamination at the site. The Contractor shall provide written notice of this meeting to all interested parties at least five days before the meeting.

M. LEED Building Submittal Requirements: The Contractor or subcontractor shall submit the following LEED Building certification items in accordance with Section 01 81 13:

1. Product data indicating location and distance from project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.

2. Material Safety Data Sheets, for all applicable products. Applicable products include, but are not limited to adhesives, sealants, and coatings.

3. Letters of Certification, Product Cut Sheet, or other items to support the information as requested by the Architect.

PART 2 - PRODUCTS

2.1 GENERAL

A. All materials to be imported to the site shall not contain detectable amounts of oil and/or hazardous materials unless otherwise approved by the Owner and the Engineer.

B. Project goal is to provide minimum of 10% of building materials (by cost, excluding labor and delivery) that are manufactured and extracted, harvested, or recovered within a 500 mile radius of the project site. If only a fraction of a product or material is extracted/harvested/recovered and manufactured locally, then only that percentage (by weight) shall contribute to the regional value. The Contractor will make all attempts to maximize the procurement of materials within this specified 500 mile radius.

2.2 STOCKPILE/CONTAINMENT MATERIALS

A. Polyethylene: 6-mil and 20-mil thickness.

B. Jersey Barriers or other barrier systems proposed by the Contractor and accepted by the Environmental Consultant for definition of work area and containment of stockpiles.

C. Hay bales.

D. Silt Fence

PART 3 - EXECUTION

3.1 GENERAL

A. Conduct all Work under this and other applicable sections in accordance with all local, state, and federal regulations and Contractor health and safety protocol.

3.2 CLASSIFICATIONS OF SOILS

A. Excavated materials shall be classified into four general groups for purposes of on-site reuse, off-site reuse, recycling, treatment, and disposal according to criteria established by applicable federal, state, and local agencies having jurisdiction over the Work. Classification is based on the results of the Precharacterization Programs. Soils may be reclassified during excavation based on field PID screening, visual and olfactory observations, and the results of additional laboratory chemical testing collected following completion of the Precharacterization Program. In no case shall any soil or material group be transported to residential settings, schools, playgrounds, or such similar sites unless otherwise approved by the Owner.

1. Group I:

a. Group I-1: Naturally-deposited soils or fill soils that contain no detectable substances other than metals at or below background conditions typical for natural soils, and meet the CTDEEP Residential Direct Exposure Criteria (RDEC), Pollutant Mobility Criteria (PMC) for areas with groundwater classified “GA” by the CTDEEP (GA-PMC), and Residential Soil Vapor Criteria (RSVC).
b. Group I-2a: Naturally-deposited soils (Polluted Soils) or artificially-deposited fill (Polluted Fill) that contain substances at concentrations above laboratory detection limits but below CTDEEP RDEC, GA-PMC, RSVC, and that are not otherwise a hazardous waste, as specified in CTDEEP Regulations.
c. Group I-2b: Naturally-deposited soils (Polluted Soils) or artificially-deposited fill (Polluted Fill) that contain substances at concentrations above laboratory detection limits but below CTDEEP RDEC, GB-PMC, RSVC, and that are not otherwise a hazardous waste, as specified in CTDEEP Regulations.
d. Group I-3: Naturally-deposited soils (Polluted Soils) or artificially-deposited fill (Polluted Fill) that contain substances at concentrations above laboratory detection limits but below CTDEEP RDEC and RSVC, above GB-PMC, and that are not otherwise a hazardous waste, as specified in CTDEEP Regulations.
e. Transport of Group I soils from the site to appropriate off-site facilities located in states other than Massachusetts shall be tracked using a trucking manifest acceptable to the Owner and prepared by the Contractor and approved by the Environmental Consultant.
f. Transport of Group I soils from the site to appropriate off-site facilities located in Massachusetts shall be tracked using MADEP Material Shipping Record & Log, which will be prepared by the Environmental Consultant.

2. Group II: Soils that contain substances at concentrations above the applicable RDEC. Unless otherwise specified, transport of Group II soils from the site to Massachusetts

receiving facilities shall be tracked using a Massachusetts Department of Environmental Protection (MADEP) Bureau of Waste Site Cleanup Material Shipping Record prepared by the Owner. For materials transported to receiving facilities in states other than Massachusetts, material shall be tracked using a trucking manifest acceptable to the Owner. A Connecticut Special Waste Authorization may be required for off-site reuse of these soils.

a. Group II-1: Soils that meet all applicable criteria (i.e., COMM-97-001 and/or facility-specific permit requirements) for reuse as daily cover, intermediate cover, or pre-cap contouring material at Massachusetts unlined landfills; or reused at other facilities proposed by the Contractor and approved by the Owner.
b. Group II-2: Soils that meet all applicable criteria (i.e., COMM-97-001 and/or facility-specific permit requirements) for reuse as daily cover, intermediate cover, or pre-cap contouring material at Massachusetts lined landfills; or reused at other facilities proposed by the Contractor and approved by the Owner.
c. Group II-3: Soils that exceed Massachusetts landfill criteria (i.e., COMM-97-001 and/or facility-specific permit requirements), but meet all applicable criteria for asphalt batching at the proposed facility, and are not classified as a RCRA Hazardous Waste. The Contractor may propose to reuse these soils at other facilities for review and approval by the Owner.
d. Group II-4: Soils that require removal to regional thermal treatment facilities or out-of-state recycling facilities, and are not classified as a RCRA Hazardous Waste. The Contractor may propose to reuse these soils at other facilities for review and approval by the Owner.
e. Group II-5: Soils that require removal to regional disposal facilities, and are not classified as a RCRA Hazardous Waste. The Contractor may propose to reuse these soils at other facilities for review and approval by the Owner.

3. Group III (Hazardous Waste)

a. Group III-1: Soils determined to contain "listed" or "characteristic" hazardous waste constituents that cannot be readily treated on-site. These soils must be transported to an approved out of state RCRA Subtitle C hazardous waste disposal or treatment facility under Uniform Hazardous Waste Manifest.
b. Group III-2: Soils determined to contain "listed" or "characteristic" hazardous waste constituents that can be readily treated on-site to remove applicable leachable contaminant concentrations. Following treatment, the material will be reclassified depending on other contaminants and disposed of at a Group II-2, II-3, II-4, or II-5 facility, as applicable.

4. Group IV (Solid Waste): Debris such as paper, glass, wood, metal, timber piles, timber cribbing, steel sheeting, and miscellaneous rubble shall be disposed at CTDEEP-approved solid waste landfills or processed and recycled if possible. Pursuant to CTDEEP's Solid Waste Regulations, if greater than ten cubic yards of Solid Waste are disposed at a location, it constitutes a Solid Waste Disposal Area. If significant amounts of Solid Waste materials are encountered in excavated materials at the site, discussion with the CTDEEP may be necessary to confirm the applicable requirements.

3.3 EXCAVATION

A. Excavate by methods that will permit observation of soils for the purpose of identifying, screening, testing, and segregating soils as necessary prior to off-site removal.

B. Excavate beyond the limits of proposed improvements to remove localized areas of stained soil which indicate visual, olfactory, or field screening evidence of contamination.

C. Conduct excavation to prevent cross-contamination of soil group classifications.

D. Segregate oversized and/or other deleterious materials from excavated soils prior to off-site removal as necessary to meet disposal facility acceptance criteria or as directed by the Owner. Segregation may consist of hand labor or mechanical screeners at no additional cost to the Owner.

3.4 ON-SITE REUSE OF EXCAVATED SOILS (AS APPLICABLE)

A. Backfill and fill material will be required to construct the proposed building. Site logistics and stockpiling will determine the feasibility of reusing select excavated soils as such backfill or fill material. The Contractor shall coordinate, sequence, and schedule work as required to enable reuse of specified soils on-site.

B. Soils designated for on-site reuse shall be processed (i.e., screened), as necessary, to remove oversize cobbles or boulders, and shall be protected from the elements (covered) at all times while stockpiled. Soil that becomes unusable due to the Contractor's activities shall be disposed off-site in accordance with this Section at the sole cost of the Contractor. Such activities are considered those that the Contractor undertakes (or does not undertake) which result in excavated soils not being able to be reused as compacted fill at the time the soils are required for reuse (e.g., inadequate dewatering, failure to protect prepared surfaces, trafficking over prepared surfaces, failure to cover stockpiles, etc.).

C. Based on environmental aspects only, the various soil groups may be reused as follows as proposed by the Contractor and accepted by the Owner and Environmental Consultant.

1. Group I-1, I-2a, and I-2b Fill soils, and Group I-1 and I-2a natural soils: Outside building footprint to underside of topsoil, pavement section, or sidewalk section; or inside building footprint to underside of slab select base course layer (no restrictions relative to placing above or below seasonal high groundwater level).

2. Group I-3, II-1, and II-3 Fill soils: Inside building footprint to underside of slab select base course layer (maintain above seasonal high groundwater level).

Final assessment of material's geotechnical suitability will be conducted by the Engineer during excavation.

D. The Contractor shall prepare a plan documenting locations and depths (and elevations) where Group I-2a (Fill), I-2b, I-3, II-1, and II-3 soils are reused on-site and the location and depths of the source material (as applicable). The plan shall be submitted to the Owner for review.

3.5 TEMPORARY STOCKPILING OF EXCAVATED MATERIAL

A. Excavated soils, except those requiring additional testing or on-site reuse, shall be loaded directly onto trucks for removal to approved off-site facilities. Soils shall not be stockpiled on-site or at temporary off-site locations unless otherwise approved by the Owner. The Contractor shall provide a local facility for temporary stockpiling of Group I soils to enable on-site reuse of excavated soils. The Contractor shall coordinate and structure its bid and its work under this Section with the Owner.

B. Soils that require additional chemical testing or are approved for reuse on-site shall be temporarily stored in stockpiles segregated by group classification and located in on-site areas (unless otherwise approved by the Owner) proposed by the Contractor and approved by the Owner.

C. The Contractor shall place Jersey barriers or other acceptable and suitable barriers around stockpiles to provide confinement. Haybales and other siltation control measures are required to prevent erosion and washing of stockpiled soils from their temporary storage locations.

D. Soils shall be stockpiled on either 20-mil polyethylene sheeting or impermeable surfaces such as asphalt. Additionally, excavated soils may be stockpiled on soils of the same group classification.

E. Stockpiles shall be securely covered with 6-mil polyethylene sheeting at the end of each workday to prevent erosion or the emission of fugitive dust, odors, and gases. Stockpiles shall be shaped and graded to facilitate surface drainage.

3.6 SOIL QUALITY MONITORING DURING EXCAVATION

A. Classification of excavated soils for on-site reuse or off-site reuse, recycling, treatment, and disposal shall be based on the Precharacterization Programs conducted by the Owner. Material located within the representative zone of the precharacterization explorations shall be assumed similar in quality to the tested material and classification is based on the test results for the representative sample(s).

B. The Contractor shall arrange for, as necessary, additional chemical testing required by the Contractor-proposed receiving facilities. The types and frequencies of testing shall be determined by the receiving facility and approved by the Owner. Testing shall be conducted by the Owner under normal turn-around conditions (i.e., two-week turn-around-testing time). Premium costs associated with turn-around-testing times less than two weeks shall be borne by the Contractor. The Contractor shall provide the equipment (e.g., excavators and/or drill rigs) to obtain the samples at no additional cost to the Owner. The Owner shall obtain the samples. The times required for additional sampling, laboratory testing, and data review by facilities shall be coordinated and considered in project sequence and schedule by the Contractor.

C. The Contractor shall coordinate all Work with the Owner. The Owner will monitor excavation of soils. Soils will be monitored for visual and olfactory evidence of contamination based on observed discoloration, texture, and odor. In addition, excavated material may be monitored with a PID to screen for the presence of volatile organic compounds (VOCs). Screening will occur in the excavation area (ambient) and will be periodically performed in jar samples headspace. Ambient PID readings will be performed in the Work zone and within 6 in. of the excavated material.

D. Soils will remain as classified based on the Precharacterization Programs unless field screening, field observations, or additional chemical testing indicate the soils to be different from the precharacterized classification. At the direction of the Owner, the Contractor shall segregate and temporarily stockpile excavated soils if they are observed to be stained, exhibit unusual odors or contain other deleterious materials. The Contractor shall arrange with the Owner to have the soils tested and reclassified as necessary prior to off-site removal.

3.7 TRUCKING MANIFEST/MATERIAL SHIPPING RECORD PROCESS

A. The Contractor shall not remove any excavated soil or material from the site until the submittal process as outlined herein has been completed to the satisfaction of the Owner and Environmental Consultant.

B. The Owner will provide interaction with the CTDEEP, MADEP or other agencies, if required.

C. The process to achieve approval at a disposal facility and prepare the required paper work may take 20 to 30 or more business days, not including the time for any additional chemical testing

requested by the Contractor-proposed facility. The Contractor should be aware of this when scheduling the project.

D. For soils and/or materials transported to approved Massachusetts receiving facilities, the Owner will provide the Contractor with the Material Shipping Record or Uniform Hazardous Waste Manifest as required. Soils shall not contain more than 20 percent asphalt, brick, concrete, wood or metal, in accordance with 310 CMR 19.017.

E. For soils and/or materials transported to receiving facilities in states other than Massachusetts, the Contractor shall prepare, maintain, and submit to the Owner the appropriate truck manifests and shipping record(s) meeting the requirements herein unless otherwise indicated by the Owner.

3.8 TRANSPORTATION OF EXCAVATED MATERIAL

A. The Contractor will be responsible for handling, re-handling, loading, transporting, and legal off-site removal of all excess excavated soils and materials to approved facilities.

B. No soils or materials shall be removed from the site without prior approval from the Owner.

C. Excavated soils and materials removed from the site shall be loaded within the site limits. All trucks leaving the site shall be covered and cleaned of debris that might fall from the trucks during transport.

D. Install, operate, maintain and remove a wheel wash at each location where construction vehicles access and depart from the site. The location shall be proposed by the Contractor and approved by the Owner.

E. The Contractor shall take measures to prevent debris from being spilled from trucks or tracked from the site onto local streets. The Contractor shall sweep streets adjacent to the site as necessary or as directed by the Owner.

F. Some Contractor-proposed receiving facilities may conduct quality assurance/quality control (QA/QC) chemical testing of soils upon arrival at the receiving facility. Although the results of the chemical analytical data obtained during the Precharacterization Programs are considered representative of the soil to be excavated, QA/QC chemical testing results conducted by the receiving facility may differ from the precharacterization results due to the heterogeneous nature of urban fill and naturally-deposited soils. Should the receiving facility's QA/QC chemical testing results differ from the precharacterization results and exceed the receiving facility's acceptance criteria, the receiving facility may reject the material, and require that it be removed from the facility. The cost of this additional handling, if required, will be borne by the Contractor.

3.9 HEALTH AND SAFETY PLANNING AND IMPLEMENTATION

A. Prepare a Health and Safety Plan that ensures the health and safety of all workers engaged in work at the site and the general public at all times when exposure to contaminated soil, contaminated groundwater, dust, odors, or gases is possible. Implement the plan throughout the execution of the work.

B. The Contractor shall monitor the excavation using the equipment described in the Contractor's Health and Safety Plan.

C. Contractor's workers who will be engaged in work at the site that might result in exposure to contaminated soil or groundwater shall attend the health and safety coordination meeting and any follow-up supplemental briefings.

D. Provide adequate health and safety training for all personnel who may come in contact with or be exposed to contaminated materials during the course of the work.

E. Provide personnel, including personnel for subcontractors that are 40-hr. OSHA trained with an 8-hr. OSHA refresher course completed within the previous calendar year. These personnel and their training shall be provided at no additional cost to the Owner. The Contractor shall provide, at the Owner's request, certificates for each worker to demonstrate compliance with this requirement.

F. As necessary, provide personnel, including personnel for subcontractors, that are confined space entry trained to complete the Work specified herein and in other Sections. These personnel shall be current in all applicable and necessary refresher courses as well. These personnel and their training shall be provided at no additional cost to the Owner. The Contractor shall provide, at the Owner's request, certificates for each worker to demonstrate compliance with this requirement.

G. Personnel who have not received training, and who are not equipped with the required protective clothing and equipment, shall not be permitted access to the site by the Contractor during the course of the work that may result in exposure to contaminated soil or groundwater.

3.10 CONTINGENCIES

A. If potentially hazardous conditions develop during the course of the Work, the Work in that specific area shall be terminated until the hazardous condition has been addressed to the Owner's satisfaction. Potentially hazardous conditions include, but are not limited to, encountering buried containers, tanks, or drums.

B. The removal of buried tanks, containers, or drums shall be performed in accordance with all applicable local and state regulations and guidelines.

C. In the event that buried containers, drums or tanks are encountered or if a release of oil or potentially hazardous materials has occurred, the Contractor shall notify the Owner immediately. The Contractor shall secure the area to prevent health risks to workers or the public and releases into the environment. The sources of the event causing the material to be considered suspect will be evaluated by the Owner. The Contractor shall notify the City Fire Department or CTDEEP, if required, upon discovery of the tank or buried container. The Contractor shall obtain permission for removal of buried storage tanks. Refer to the attached CTDEEP UST environmental program fact sheets for additional guidance.

D. The impact on the Work should be evaluated and, if necessary, the Contractor's Health and Safety Program should be revised in response to the unforeseen conditions.

3.11 WASTE DISPOSAL

A. Waste Management: Disposal and recycling of waste shall comply with requirements of Section 01 81 13. Provide documentation of compliance.

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. The Base Contract Price shall include all costs for submittals; transporting; stockpiling (on and/or off-site); on-site reuse; off-site reuse, recycling, treatment, and disposal (e.g., tipping, transportation, taxes, fees, fuel surcharges, handling, and re-handling, and all other incidentals); coordinating with the Owner; preparing and providing required documentation (letters to and from facilities); equipment (e.g., excavators and/or drill rigs) to enable sampling for additional testing; permit preparation and filling fees; work required by the disposal facility to accept the material (e.g., hoe-ramming and screening concrete to a size acceptable for trucking and/or for the disposal facility); and other incidental work to remove excavated soils and materials from the site or reuse on-site.

B. No separate measurement or payment will be made for handling, re-handling, screening and segregation of materials and soils by hand or mechanical means, reuse, filling, construction vehicle wheel wash, management, stockpiling (on- or off-site), permit preparation and filing, emission control measures, equipment, police details, dust monitoring, dust control, surveying Work listed in other Sections or other associated items or Work considered incidental to the Work of this Section.

C. No separate measurement and payment will be made for removal and disposal of demolished existing excavation support systems, demolished existing utilities, demolished existing foundation or floor slab elements, and pavements. Removal and disposal of these materials shall be part of the Base Contract Price.

D. No separate measurement and payment will be made for Health and Safety. The Base Contract Price shall include furnishing all material, mobilization, OSHA trained and certified labor, confined space trained and certified labor, equipment, tools, subcontractors and testing agencies associated with on-site monitoring programs, and incidentals necessary to complete the Work specified herein.

E. No separate measurement and payment will be made for re-use of materials including coordinating on-site reuse locations with the Owner and Engineer, over-excavation in areas proposed for reuse, proof-compaction of subgrades, placement and compaction of reuse materials in engineered lifts, removal of oversized materials during placement (if any), and off-site removal of the mined natural soils displaced by the reuse operation.

F. Measurement of the soil groups transported from the site to the various receiving facilities shall be per ton measured by scale at the receiving facility to the nearest 0.1-ton. If the receiving facility does not have a scale, the weight per truck load and percent the truck is filled shall be agreed upon by the Contractor and Owner PRIOR to each truck leaving the site. The basis for the weight per truck shall be the weight of the initial trucks leaving the site that are weighed by the Contractor and agreed to by the Owner. Prior to hauling, up to five trucks (for each truck type and for each material type (e.g., fill, organic soils, sand, clay, glacial soils, bedrock, etc.)) shall be weighed to determine the agreed on weight for each load. Up to 5 percent of subsequent trucks shall be weighed by the Contractor at the request of the Owner. This process shall be applicable to other group classifications that are not weighed at the end destination.

G. Should the receiving facilities QA/QC chemical testing results exceed the facilities acceptance criteria, the receiving facility may reject the material and require that it be removed from the facility by the Contractor. No separate measurement or payment will be made for double handling the material.

4.2 PAYMENT

A. Bidding Instructions: See BP 31.01 Scope of Work.

B. This table provides estimated quantities for excavated fill soils anticipated within and immediately adjacent to the new building footprint only, noting that excavated natural soils shall be removed from the site and legally disposed at a non-landfill facility proposed by the Contractor during bidding and accepted by the Owner, under the Base Contract Lump Sum.

Soil Group	Est. Qty. Fill Soil c.y. (tons)	Off-site Removal Locations
I-1 Clean fill with only background metals	350 (600)	Massachusetts Unlined Landfill
I-2a Polluted Fill below RDEC, GA-PMC, RSVC	375 (650)	Massachusetts Unlined Landfill
I-2b Polluted Fill below RDEC, GB-PMC, RSVC	250 (425)	Massachusetts Unlined Landfill
I-3 Polluted Fill below RDEC and RSVC, above GB-PMC	800 (1,350)	Massachusetts Unlined Landfill
II-1 MA Unlined Landfill	550 (950)	Massachusetts Unlined Landfill
II-2 MA Lined Landfill	--	--
II-3 Asphalt Batching	250 (425)	Asphalt Batch Recycling Facility
II-4 Thermal Treatment	--	--
II-5 Regional Disposal	--	--
III-1 Off-site Disposal	--	--
III-2 On-site Treatment	--	--
IV Solid Waste	100 (200)	--

Notes:
1. The Contractor shall provide name(s) and locations(s) of proposed facility(s) for off-site removal locations.
2. Actual quantities will vary depending on many factors such as contractor sequencing, stockpiling, excavation support approaches (open cut vs. temporary wall systems); dewatering performance; protection of subgrades; conditions exposed at the time of excavation; the Contractor's ability to reuse excavated soils; conditions between exploration locations; and other factors. The tabulated quantities assume temporary excavation support walls positioned within 5 ft of building foundation walls.

END OF SECTION 02 60 00

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PART 1 - GENERAL

1.1 DESCRIPTION

A. General: Provide cast-in place concrete in accordance with requirements of the Contract Documents.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 018110, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

1.2 STANDARDS

A. Except as modified by governing codes and by the Contract Documents, comply with the applicable provisions and recommendations of the following:

1. ACI 301-99 "Standard Specifications for Structural Concrete".
2. ACI 302.1R-89 "Guide for Concrete Floor and Slab Construction".
3. ACI 304R-00 "Guide for Measuring, Mixing, Transporting and Placing Concrete".
4. ACI 304.2R-96 "Placing Concrete by Pumping Methods".
5. ACI 305R-99 "Hot Weather Concreting".
6. ACI 306.1R-90 "Standard Specification for Cold Weather Concreting".
7. ACI 308-01 "Standard Practice for Curing Concrete".
8. ACI 309R-96 "Guide for Consolidation of Concrete".
9. ACI 311.1R-99 "ACI Manual of Concrete Inspection", ACI 311.4R "Guide for Concrete Inspection, ACI 311.5R-02 "Batch Plant Inspection and Field Testing of Ready Mixed Concrete".
10. ACI 315-99 "Details and Detailing of Concrete Reinforcement".
11. ACI 318-02 "Building Code Requirements for Reinforced Concrete".
12. ACI 347-01 "Guide to Formwork for Concrete".
13. ACI 211.1-99 "Standard Practice for Selecting Proportions for Normal, Mass and Heavy Weight and Mass Concrete".
14. ACI 211.2-98 "Recommended Practice for Selecting Proportions for Structural Lightweight Concrete".
15. CRSI-WCRSI "Placing Reinforcing Bars".
16. AWS D1.4-98 "Structural Welding Code - Reinforcing Steel".
17. AASHTO TP 23, “Standard Method of Test for Water Content of Freshly Mixed Concrete Using Microwave Oven Drying”
18. SDI “Design Manual for Composite Decks, Form Decks, and Roof Decks”
19. AISC, Third Edition, LRFD 1999 “Code of Standard Practice for Steel Buildings and Bridges”

B. Where the language in any of the documents referred to herein is in the form of a recommendation, suggestion or guide; such recommendation or, suggestion or guide shall be deemed to be mandatory under this Contract.

1.3 SUBMITTALS

A. Samples: Submit samples as requested.

B. Shop Drawings

1. Submit shop details and placing drawings for reinforcing steel.
2. Submit detailed drawings showing locations of all construction joints, curbs, depressions, sleeves and openings.

C. Description: Submit a complete description of the system proposed for meeting the specified floor slab flatwork tolerances. Submit survey data from a minimum of two previous slab installations to demonstrate capability to satisfy specified tolerances.

D. Mill Tests: Submit, as requested, certified mill test reports for cement, metal reinforcement and welded wire fabric.

E. Certifications for Admixtures: As specified under admixtures.

F. Test Reports

1. Submit Preliminary Design Mix Reports at least three weeks prior to the beginning of the work. Submit separate Design Mix Report for each class of concrete and construction procedure anticipated.

G. Certifications for Joint Fillers, “Dry-Shake” Hardeners, Sealing/Densifying Compounds, and Curing Compounds: As specified under products and elsewhere in the specification and notes.

H. Product data for waterstops.

I. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
   a. Include statement indicating costs for each product having recycled content.

2. Product Certification for Credit MR 5: For products and materials required to comply with requirements for Regional Materials including location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material.Include statement indicting cost for each regional material and the fraction by weight that is considered regional.

1.4 PRODUCT HANDLING

A. Comply with ACI 301, Section 5. Stockpile and use aggregates in a manner which minimizes moisture content variation.

1.5 ENVIRONMENTAL CONDITIONS

A. Cold Weather Concreting: Comply with ACI 306R.

B. Hot Weather Concreting: Comply with ACI 305R.

1.6 QUALITY CONTROL

A. Preliminary Design Mix Tests

1. Prepare design mixes in accordance with ACI 301, Section 4.2.3 on the basis of previous field experience or trial mixes. Bear all costs in connection with the design of concrete mixes. Separate design mixes are required for each anticipated and/or actual change in mix materials. Each design mix shall be fully identified as to its proposed use.
2. Whenever a change of brand or source for any of the concrete ingredients occurs, additional "preliminary tests" will be required and the cost of these tests shall be borne by the Contractor.
3. Proposed mix designs, preliminary testing procedures and results will be subject to the review and approval of a testing agency engaged by the Owner. Molds for preliminary tests will be provided by the Owner's Testing Laboratory and will be of the same type and manufacture to be used on the Project.
4. Make one test for each design mix to verify that the total chloride (C1) ion content is within the specified limits. Perform chloride tests in accordance with "Standard Method of Sampling and Testing for Total Chloride Ion in Concrete" as contained in Report No. FHWA-RD-77-85 published by U.S. Department of Transportation, Federal Highway Administration.
5. Mix design report for concrete specified to be air entrained shall include ASTM C173 or ASTM C231 test results.

B. Plant and Field Tests and Inspection

1. Concrete work will be subject to inspection and tests at the plant and in the field. Field and laboratory inspections and tests will be made by a testing laboratory engaged by the Owner, without expense to the Contractor. Records of such tests and inspections will be submitted to the Engineer, covering the quality and quantity of concrete materials, mixing and placing of concrete, concrete formwork, placing of reinforcing steel and the general progress of the work.
2. Facilitate the work of, and cooperate with, the inspectors. Notify the inspectors when formwork and reinforcing steel is in place in order to facilitate inspections. Do not place concrete until these inspections have been completed and all deficiencies reported by an inspector have been corrected to the inspector's satisfaction. On steel framed structures, the entire frame below the concrete level to be placed shall be plumbed, surveyed, inspected and approved by Owner's Structural Steel Testing Agency prior to concrete placement. Concrete placed prior to all required approvals is subject to removal.
3. At the start of the Project and Monthly throughout the course of the Work, the Owner's Testing Laboratory will check the following for compliance with the Contract Documents and submit a weekly report to the Engineer:
   a. Cement (ASTM C150)
   b. Aggregate (ASTM C33 or C330)
   c. Fly Ash (ASTM A618)
   d. Admixture (ASTM C494 or C1017)
4. If ready-mix concrete is used, each load of concrete arriving at the job shall be accompanied by a delivery ticket which shall be subject to checking by the Owner's Testing Laboratory at the plant and field and which shall contain the following minimum information:

a. Batch plant of origin.
b. The yardage of concrete.
c. The class of concrete.
d. The amount and type of aggregates.
e. The amount and type of cement.
f. The amount(s) and type(s) of admixtures.
g. The amount of water.
h. The exact time the last materials were discharged into the delivery truck. If, upon reaching the Project site, the concrete cannot be placed within the specified time limits or if the class of concrete delivered is incorrect, the inspector will reject the load for use, and it shall be removed from the site at the Contractor's expense.

5. Batch Plant Inspection: At the start of the Project and at least once each month until the completion of the Concrete work, the Owner's Testing Laboratory will observe and evaluate the following for compliance with the Contract Documents and submit a report to the Engineer:
   a. Condition of batching equipment.
   b. Condition of materials.
   c. Inspect aggregate stockpiles and storage and bring to the attention of the concrete producer any practices which are causing segregation or contamination within the stockpiles.
   d. Type of materials used.
   e. Inspect trucks used to transport concrete to assure that they are clean and in condition to mix and to deliver a uniform mix.
   f. Mixing time, delivery time.
   g. Additional pertinent controls; depending on weather, job conditions, and other factors affecting the Work.
6. Chloride: The testing laboratory will take specimens of each class of concrete and will perform one test for each 100 cu. yds. to verify that the total chloride ion content is within the specified limits. If the total chloride ion content exceeds the specified limits, the testing laboratory shall perform, at the Contractor's expense, a water soluble chloride ion test in accordance with "Standard Method of Sampling and Testing for Water-Soluble Chloride Ion in Concrete" as contained in Report No. FHWA-RD-77-85.
7. Compression Test: The Owner's Testing Laboratory will supply all molds required for tests as described below, using molds of the same type and manufacture for making all test specimens. The testing laboratory will take specimens of each class of concrete beginning with the first truck and as follows:
   a. At least four (4) specimens for each 50 cu. yds. or fraction thereof of each class of concrete and in any case not less than four (4) specimens for any one day's operations shall be sampled directly from the mixer.
   b. In addition to specimens sampled directly from the mixer, test cylinders for pumped concrete and superplasticized concrete shall also be made from concrete sampled at the point of deposit or as directed by the engineer designated for inspection. These test cylinders shall be separate and distinct from those made from the mixer, and shall be made from the
   same batch and cured and tested in the same manner as described as described for the samples at the point of deposit shall be a minimum of one set of 2 cylinders for every 150 cu. yds. or fraction thereof for each class of concrete mixed in any one day's concreting. When concrete is being placed directly from the mixer into the forms without any intermediate conveyance, the additional cylinders will not be required.
   c. Samples will be obtained in accordance with ASTM C172.
   d. The testing laboratory will comply with ASTM C31 in making, curing and

subsequently handling test specimens, except as modified herein. Specimens will be tested in accordance with ASTM C39.

e. For specimens sampled directly from the mixer, the cylinders will be placed in laboratory storage under moist curing conditions at approximately 70 deg. F. within 24 hours after molding and maintained therein until tested. One specimen of each set will be tested at seven days. If the seven day strength is below 60% of design strength, the Engineer and the Contractor will be immediately notified. Two cylinders of each set will be tested at 28 days. The fourth cylinder of each set shall be a reserve cylinder for testing at 56 days if the average 28 day strength does not meet specified strength.

f. For specimens sampled at the point of deposit, cylinders will be stored and maintained as above and will be tested at 28 days.

8. Air Content: Test cylinders in accordance with ASTM C173 or ASTM C231. Test air each time test cylinders are made or as directed by the Engineer.

9. Water Test: The water content of freshly mixed concrete will be tested each time cylinders are made and as directed by the Engineer in accordance with AASHTO T 318.

10. Unit Weight: Test unit weight in accordance with ASTM C138 each time test cylinders are made.

a. Always check the first truck of a placement.

11. Slump: Test in accordance with ASTM C143.

a. Test each sample taken for cylinders. For concrete containing superplasticizer added at the site, one test shall be made prior to addition of the admixture, and another test after addition and mixing. For pumped concrete, one test shall be made at the pump and one at the point of deposit. Provide slump cone(s) and rod(s) for use on the job at all times.

12. Flatwork Tolerances: The Owner's Testing Agency will survey the finished floor surfaces in a manner agreed to by the Engineer to verify compliance with the flatwork tolerances specified.

13. The Owner's Testing Agency will perform other testing and inspections as required by local, state and federal codes.

C. Standard of Strength Control

1. Until sufficient test data is available to calculate the standard deviation, the required average concrete strength shall exceed the specified design strength by at least the following:

a. Design strength 3000 psi to 4800 psi: 1200 psi

b. Design strength 4801 psi to 6000 psi: 1500 psi

2. Each 28-day compression test report shall clearly indicate, as of the report date and for the class of concrete being reported:

a. the average of the latest three test results;

b. the lowest average of three consecutive test results;

c. the percentage of tests falling below specified strength;

d. the lowest single test result.

3. Strength Requirements and Compliance Therewith: Concrete will be considered to meet strength requirements of the Specifications when in compliance with ACI 301, Section 1.7.4, Strength of Structure, except as modified by local code.

D. Enforcement

1. If field test performed by the Owner's Testing Laboratory indicate non-compliance with the Contract Documents, the remainder of the batch of concrete from which the sample in question was taken will be rejected for use and shall be removed from the site at the Contractor's expense.
2. When non-compliant test or trends are observed by the Owner's Testing Laboratory, such information will be relayed expeditiously by telephone, fax or email to the Engineer, the Contractor and the concrete supplier and confirmed promptly in writing on different colored paper. The concrete supplier shall take immediate action to correct any deficiency.
3. Concrete found by laboratory test to have excess chlorides will be subject to removal.
4. If concrete strength tests do not comply with the strength requirements of the Contract Documents, the Engineer may require that test specimens be cut from the structure at locations designated. Specimens shall be secured and tested in accordance with ASTM C42, petrographic analyses shall be performed in accordance with ASTM C856 and/or other tests shall be performed as required by the Engineer. These tests, if required, will be made at the Contractor's expense. If the results of these tests indicate non-compliance, the Engineer may require that the concrete be removed from the structure or other corrective action at no additional cost to the Owner.
5. Other Tests: In the event that laboratory tests taken from any part of the structure indicate an apparent failure to develop the ultimate strengths required at 45 days, the Engineer may, at his discretion, order other tests to be made on the portion of the structure affected to the determine the adequacy of such portion to sustain the loads for which its members are designated. These tests, if required, will be made at the Contractor's expense, and shall conform to the requirements of ACI 318 and
local codes. If the structure, or any part of the structure, cannot pass the tests, it shall be removed and replaced at the Contractor's expense.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General

1. The total chloride (with AASHTO T 318.) ion content in the entire mix shall not exceed 0.15% of the weight of cement.

B. Portland Cement: ASTM C150, Type 1. Use only one brand of cement from one mill throughout the work unless otherwise approved by the Engineer. The alkali content shall not exceed 0.6% unless:

1. The manufacturer certifies that no alkali reactivity is produced with the proposed combination of materials when tested in accordance with ASTM C227, or
2. A pozzolan, proven by ASTM C441 to be effective in preventing excessive expansion due to alkali-aggregate reaction, is included in the mix.

C. Admixtures

1. Each admixture manufacturer shall certify to the appropriateness of the use of their admixture(s) in the combination, dosages, batching and construction procedures proposed. All structural concrete shall contain a water reducing

admixture or a high range water reducing admixture.

2. Air-Entraining: Comply with ASTM C260; providing one of the following:
   a. "MB-VR" (Master Builders Co.).
   b. "Daravair" (Construction Products Div., W.R. Grace & Co.).
   c. "Sika-Aer" (Sika Corp.).
   d. "Air-Mix" or "AEA-92" (Euclid Chemical Co.).
3. Water Reducing Comply with ASTM C494, Type A; provide one of the following:
   a. "WRDA with Hycol" (Construction Products Division, W.R. Grace & Co.).
   b. "Eucon WR-75", "WR-89" or “Eucon MR” (Euclid Chemical Co.).
   c. "Pozzolith 200N" (Master Builders Co.).
   d. "Plastocrete 161" (Sika Chemical Corp.)
4. Water Reducing (Retarding): Comply with ASTM C494, Type D; provide one of the following:
   a. "Plastiment" (Sika Chemical Corp.).
   b. "Eucon Retarder-75" (Euclid Chemical Co.).
   c. "Daratard-17" (Construction Products Div., W.R. Grace & Co.).
   d. "Pozzolith 100XR" (Master Builders Co.).
5. Accelerating Admixture: Comply with ASTM C494, Type C or E. Admixture shall be chloride-free and non-corrosive. Provide one of the following:
   a. "Pozzutec 20" (Master Builders Co.).
   b. "Daraset" (Construction Products Div., W.R. Grace & Co.)
   c. "Accelguard 80", “Accelguard 90” or “Accelguard NCA” (Euclid Chemical Co.).
6. High Range Water Reducing Admixture (Superplasticizers): Comply with ASTM C494, Type F. For all concrete, use only with prior approval of the Engineer. Provide one of the following:
   a. "Eucon 37", “Eucon 1037” or “Plastol 5000” (Euclid Chemical Co.).
   b. "Rheobuild 1000" (Master Builders Co.).
   c. "Sikament FF" (Sika Chemical Corp.).
   d. "WRDA-19" (Construction Products Div., W.R. Grace & Co.).
7. High Range Water Reducing Retarding Admixture (Superplasticizers): Comply with ASTM C494, Type G. Use only with prior approval of the Engineer. Provide one of the following:
   a. "Eucon 537" (Euclid Chemical Co.).
   b."Rheobuild 716" (Master Builders Co.).
   c. "Daracem 100" (Construction Products Div., W.R. Grace & Co.).
8. Corrosion inhibiting Admixture: ASTM C1582.
9. Other Admixtures: Use only with the prior written approval of the Engineer. Do not use any admixtures which contain chlorides.

D. Water: ASTM C94. Clean, clear, odorless, potable. Wash water shall not be used.

E. Aggregates

1. Fine Aggregate: For Uses Not Otherwise Specified: ASTM C33.
   a. Minimum 12% passing No. 50 sieve.
   b. Minimum 3% passing No. 100 sieve.
   c. Fineness Modulus: Minimum 2.5, maximum 3.0.
   d. For Pumped Concrete: 15% to 30% passing a No. 50 sieve; 5% to 10% passing No. 100 sieve; FM minimum 2.4, maximum 3.0, with maximum daily variation 0.20.
2. Coarse Aggregate: For Uses Not Otherwise Specified: ASTM C33.

a. Maximum size 57.
b. Size 67 for general use.
c. Size 7 or 8 for pumped concrete and tight pours.

3. Lightweight coarse aggregate: ASTM C330.
4. Combined Aggregate Gradation: Combined aggregate gradation for slabs and other designated concrete shall be 8% - 18% for large top size aggregates (1½ in.) or 8% - 22% for smaller top size aggregates (1 in. or ¾ in.) retained on each sieve below the top size and above the No. 100.

F. Ground Granulated Blast Furnace Slag: ASTM C989, Grade 120. The ratio of the amount of the ground granulated blast-furnace slag to the total amount of ground granulated blast furnace slag and cement in the mix not to exceed 40 percent of cementitious content and based on a successful test slab placement. Provide minimum 25 percent (GGBFS + FA) of cementitious content.

G. Fly Ash: ASTM C618, Class C or F. No additives or contaminants derived from the fly ash precipitation process which are detrimental to the concrete (such as soda ash) shall be allowed. The fly ash producer shall have a minimum of 5 years experience in the production of acceptable fly ash and shall practice an effective quality control program to guard against contamination of the fly ash. . Provide minimum 25 percent (GGBFS + FA) of cementitious content.

H. Metal Reinforcement: ASTM A615, new billet steel, Grade 60 unless otherwise shown.

1. For fabrication tolerances conform to ACI 117, Section 2.2.
2. All reinforcing bars shall have distinguishing marks plainly indicated thereon, which shall agree with those given on the shop drawing relating to or calling for the bars.
3. Epoxy Coated reinforcement shall comply with ASTM A775 and ASTM D3963. Comply with CRSI recommendations. The manufacturing plant shall be CRSI Epoxy Plant Certified.

I. Welded Steel Wire Fabric: ASTM A185, 70,000 psi minimum ultimate tensile strength; size shown on Drawings.

J. Supports for Reinforcement: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Use wire-bar-type supports complying with CRSI specifications. All bar supports shall be galvanized.

1. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs that are plastic protected (CRSI, Class 1) or stainless steel protected (CRSI, Class 2).

K. Grout: ASTM C1107, free of gas-producing or gas-releasing agents, oxidizing catalysts, inorganic accelerators and chlorides. If requested by the Engineer, grout a sample 4 ft. x 4 ft. x 1/2 in. plate in the field and demonstrate a minimum of 95% bearing after curing 14 days. Cure grout in accordance with manufacturer's instructions. Provide one of the following:

1. Non-Metallic
a. "Five Star Grout" (U.S. Grout Corp.).
b. "Masterflow 928" (Master Builders Co.).
c. "Euco NS" (Euclid Chemical Co.).

2. High Flow Grout:
   a. “Hi-Flow Grout” (Euclid Chemical Co.)
   b. “Masterflow 928” (Master Builders Co.)

L. Curing Materials: One of the following:

1. Clear Curing and Sealing Compound (VOC Compliant, 350 g/l): Liquid type membrane-forming curing compound, clear styrene acrylate type, complying with ASTM C1315, Type I, Class A, 25% solids content minimum. Moisture loss shall be not more than 0.40 Kg/m^2 when applied at 300 sq. ft./gal. Manufacturer's certification is required. Subject to project requirements provide one of the following products:
   a. "Super Diamond Clear VOX" or Super Rez Seal VOX” (Euclid Chemical Co.)
   b. "Masterkure 100W" (Master Builders Co.).
2. Curing Compound (Strippable): All other slabs, where indicated on the drawings or where approved, shall be cured with the specified strippable curing compound conforming to ASTM C 309. For use on surfaces to be covered with finish or coating material applied directly to concrete, such as liquid densifier/sealer, waterproofing, dampproofing, membrane roofing, flooring, painting, and other coatings and finish materials. Provide:
   a. “Kurez DR VOX” (Euclid Chemical Co.)
3. Polyethylene Film: ASTM C171.
4. Waterproof Paper: ASTM C171.
   Verify compatibility with applied floor finishes.

M. Liquid Sealer/Densifier: High performance, deeply penetrating concrete densifier; odorless, colorless, VOC - compliant, non-yellowing siliconate based solution designed to harden, dustproof and protect concrete floors subjected to heavy vehicular traffic and to resist black rubber tire marks on concrete surfaces. The compound must contain a minimum solids content of 20% of which 50% is siliconate. Provide products from one of the following:

1. "Euco Diamond Hard" (Euclid Chemical Co.).
2. “Seal Hard” (L & M Construction Co.)

N. Expansion Joint Filler Strips: Preformed sponge rubber strips complying with ASTM D1752, Type I. Verify compatibility with any joint sealers to be applied over the filler strip.

O. Formwork

1. For unexposed surfaces and rough work, use Exterior Type Douglas Fir, Grade B-B, (concrete form) Plywood, conforming to NBS PS-1, minimum 3/4 in. thick, or undressed lumber, No. 2 common or better. Before reusing forms, withdraw nails and thoroughly clean surfaces to be in contact with concrete.
2. For exposed surfaces not otherwise specified use Special exterior Type Douglas Fir, Grade A-B plywood, confirming to NBS PS-1, minimum 3/4 in. thick and constructed so that finished concrete will be straight, smooth, dense, free from honeycombs, bulges, or depressions. Keep joints between plywood sections to a minimum and make tight and strongly backed so that adjoining edges remain

flush and true. Unsightly joint marks will not be permitted. Cover joints on exposed surfaces with smooth-faced vinyl tape.

P. Form Ties: For securing forms where surfaces will be exposed in the finished work, use tie screws with removable plastic cones, removable bolts, special removable tie wires or Series 300 stainless steel snap ties. For all other forms, use either bolts or wires. Use ties of such type that when forms are removed, no metal is closer than 1-1/2 in. from the finished concrete surface.

Q. Form Coating: Provide commercial formulation form-coating compounds with a maximum VOC of 350 mg/l that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

R. Resinous flooring: See 09 67 10.

S. Vapor Barrier: A flexible, preformed sheet membrane having a water-vapor permeance rate no greater than 0.012 perms when tested in accordance with ASTM E 154, Section 7 and otherwise conforming to ASTM E 1745, Class A. Provide one of the following:

1. "Stego Wrap (15-Mil) Vapor Barrier" (Stego Industries LLC, San Juan Capistrano, CA [877-464-7834])
2. "Griffolyn Vaporguard" (Reef Industries)
3. "Premoulded membrane with PLASMATIC CORE" (W.R. Meadows).

T. Threaded rebar fasteners/couplings: Threaded inserts and couplings for rebar splices, to develop at least 125% of the specified rebars yield strength. F.C. Dayton Barsplice, Inc. couplings or approved equal.

U. Polymer Patching Mortar: "Euco Thin Coat, Concrete Coat" (horizontal repairs), "Verticoat or Verticoat Supreme" (vertical and overhead repairs) by The Euclid Chemical Co. or "Sikatop 121 or 122" (horizontal repairs), "Sikatop 123" (vertical and overhead repairs) by Sika Chemical Corp. These patching mortars may be used when color match of the adjacent concrete is not required. Prior approval by the Engineer is required.

V. Underlayment Compound (If Required): Free-flowing, self-leveling, pumpable cementitious base compound, "Flo-Top" by The Euclid Chemical Co. The compound shall exhibit the following properties:

Compressive Strength (ASTM C109)	- 3600 PSI @ 7 days
	- 5000 PSI @ 28 days
Bond Strength (ASTM C1042)	- 700 PSI @ 7 days
	- 1000 PSI @ 28 days

W. Repair Topping: Self-leveling, polymer modified high strength topping. Product shall be "Thin-Top Supreme" by The Euclid Chemical Co. The topping shall exhibit the following properties:
Chaplin Abrasion Test - 0.02 mm (0.0079") maximum @ 28 days (British Standard 8204)

X. Bentonite Waterstops: , Minimum 75% sodium bentonite, Cetco Volclay Waterstop RX-101T, or approved equal.

2.2 MIXES

A. Classes of Concrete: The strength, unit weight and other design parameters of the concrete for each portion of the structure shall be in accordance with the requirements indicated on the Drawings.

B. Proportioning of Concrete

1. Assume full responsibility for the strength, consistency and handling of concrete. Design mixes in accordance with ACI 211.1 or ACI 211.2 (as modified by local code).
2. Use the minimum amount of water necessary to produce a mix that can be worked readily into corners of forms and around reinforcement without permitting segregation of materials or free water to collect on surfaces.
3. Adjust the consistency of any mix to allow for specific placing methods and conditions. The slump of concrete filling small, thin or complicated forms shall be greater than for large masses, the degree of slump being governed by the least dimensions of the form. Maximum design slump shall be not more than 3 in. for slabs and sloping concrete surfaces and not more than 4 in. for all other concrete. For concrete proportioned with a superplasticizer, the design slumps shall be a maximum of 3 in. prior to addition of the admixture and a maximum of 8 in. after addition and mixing.
4. Measure materials for concrete by weighing. Separately weigh each size of aggregate and the cement; cement accurate within 1%, aggregates accurate within 2%. Cement in sacks of ninety-four pounds need not be weighed, but weigh bulk cement and fractional packages. Measure mixing water by weight or volume accurate within 1%.
5. Durability: Air entrain concrete, where shown, in accordance with ACI 301, Section 4.2.2.4, Air Content, except that the air content shall comply with ACI 318, Chapter 4 for Severe Exposure. Maximum water/cement ratio shall be 0.50 (4000 psi at 28 days or more) for concrete subject to freezing and thawing. All concrete subjected to deicers and/or required to be watertight shall have a maximum water/cement ratio of 0.45 (4500 psi at 28 days or more). All reinforced concrete subjected to brackish water, salt spray or deicers shall have a maximum water/cement ratio of 0.45 (5000 psi at 28 days or more). All trowel finished interior slabs, subjected to vehicular traffic, shall have a maximum w/c ratio of 0.40.

6. For all concrete above grade and within 2 feet of vehicle traffic, provide corrosion inhibiting admixture sufficient to provide chloride ion protection of at least 13 pounds of per cubic yard of concrete.

7. Fly Ash: Use a maximum of 150 lbs. per cu. yd. Fly ash shall not exceed 20% of total cementitious materials. . Provide minimum 25 percent (GGBFS + FA) or cementitious content.

8. Pumped Concrete (normal concrete): Comply with ACI 304.2R.
   a. Provide separate design mixes for each 200 ft. distance (sum of horizontal and vertical) from the pump.
   b. The maximum slump shall be 8 in. at the pump after the addition of the high range water-reducing admixture. The concrete shall arrive a the job site at a slump of 2 in. – 3 in. (3 in. to 4 in. for concrete receiving a “shake-on” hardener or lightweight concrete), be verified, then the high-range water-reducing admixture added to increase the slump to the approved level. All other concrete shall have a maximum slump of 4 in.

c. Confirm pumpability of mix design by performing a pump test in accordance with ACI 304.2R, section 4.9, unless results from a previous use of the proposed mix in a similar pumping operation are acceptable to the Engineer.

C. Self-Consolidating Concrete (SCC): Compressive strength and water/cement ratio as indicated on the plans. Test placement on the jobsite will be required to confirm flow, setting time, and self-consolidating characteristics. All self-consolidating concrete shall contain the specified high-range water-reducing admixture and viscosity-enhancing admixture when and as required.

D. “Quick-Dry” Concrete: Maximum W/cm – 0.40, superplasticized, 3% maximum air content. The floor finish shall be as required by the manufacturer of the specified floor coating or covering

E. Cement Fill

1. Mix cement fill for steel pan-type stairs and platforms in the proportions, by weight, of one part Portland cement, 1-1/2 parts sand and 1-1/2 parts coarse aggregate. Grade the coarse aggregate from 1/8 in. with at least 95% passing a 3/8 in. sieve and not more than 10% passing a No. 8 sieve.

PART 3 - EXECUTION

3.1 PRE-CONSTRUCTION MEETING

A. At least one week prior to commencement of concrete work, meet at the Project site to review methods and sequence of concrete construction, standard of workmanship, material selection, testing and quality control requirements, review of the proposed design mixes, placement procedures, off-site batching requirements, coordination of the work with other trades and other pertinent topics related to the Work. The contractor shall send a pre-construction meeting agenda to all attendees 20 days prior to the scheduled date of the meeting. Meeting shall include the following:

1. Owner's Representative
2. Architect/Engineer
3. Construction Manager/General Contractor
4. Concrete Subcontractor
5. Owner's Testing Laboratory(s)
6. Ready mix concrete supplier
7. Admixture Manufacturer(s) Representative(s)
8. Lightweight Aggregate Supplier
9. Precast concerete erector
10. Any other subcontractor and/or material supplier or manufacturer required.

B. The minutes shall include a statement by the concrete contractor indicating that the proposed mix design and placing techniques will produce the concrete quality required by these specifications.

3.2 FORMWORK AND VAPOR BARRIER

A. General: Design, erect, support, brace, and maintain formwork to support vertical and lateral, static and dynamic loads that might be applied until concrete structure can support

such loads. Forms shall be well constructed, carefully aligned, substantial, firm, securely braced and fastened together in their final position and set to give the finished structure the specified camber, plus allowance for shrinkage and settlement.

1. Forms shall conform to the lines, dimensions and shapes of concrete shown providing for openings, offsets, sinkages, reglets, chamfers, blocking, screeds, anchorages, inserts, recesses, keys, slots, projections and other features as required.
2. Make forms clean and free of foreign material before placing concrete. Solidly butt joints and provide backup at joints to prevent leakage of cement paste.
3. Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses, and chases from other trades providing items. Accurately place and support items built into forms.

B. Design of Formwork

1. Comply with ACI 301, Section 2.2.2.
2. Provide forms so that no discernible imperfection is in evidence in finished concrete surfaces due to deformation, bulging, jointing, or leakage of forms. Design forms to withstand the action of mechanical vibrators.
3. Design formwork to be readily removable without impact, shock or damage to cast-in-place concrete surfaces and adjacent structures of surfaces. Provide crush plates or wrecking plates where stripping may damage surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses and the like to prevent swelling and to provide for easy damage free removal.

C. Tolerances

1. Comply with ACI 301, Section 2.3.1.2, except as otherwise noted.
2. Comply with PCI recommendations regarding tolerances for embedded anchor bolts and other items which will connect to the precast concrete structure.
2. Variation from Plumb
   a. In any 10 ft.: 1/8 in.
   b. In entire length/height: 1/2 in.
3. Variation from Building Line
   a. In any 10 ft.: 1/4 in.
   b. In entire length/height: 3/4 in.

D. Preparation of Form Surfaces

1. Comply with ACI 301, Section 2.2.1.3.
2. Use non-staining mineral oil or form lacquer.

E. Vapor Barrier

1. Preparation: Ensure that base material is approved by Geotechnical Engineer. Level and compact base material.

2. Installation: Install vapor barrier in accordance with manufacturer's instructions and ASTM E 1643.

1. Unroll vapor barrier with the longest dimension parallel with the direction of the concrete placement.
2. Lap vapor barrier over footings and/or seal to foundation walls.
3. Overlap joints 6 inches and seal with manufacturer's tape.
4. Seal all penetrations (including pipes) per manufacturer's instructions.
5. No penetration of the vapor barrier is allowed except for reinforcing steel and permanent utilities.
6. Repair damaged areas by cutting patches of vapor barrier, overlapping damaged area 6 inches and taping all sides with tape.

3.3 REINFORCEMENT

A. General: Comply with ACI 301, Section 3. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials that reduce or destroy bond with concrete.

B. Tolerances: Comply with ACI 301, Section 3.3.2.1.

C. Placing

1. Comply with ACI 301, Section 3.3.2. When splices not shown on the Drawings are approved by the Engineer, such splicing shall conform to ACI 318.
2. Place reinforcing bars having assigned positions so that distinguishing marks agree with those given on the shop drawings relating to or calling for the bars.
3. Secure all reinforcing bars in place with high-density plastic supporting and spacing devices and metal tying devices. Reinforcing in concrete members that have one or more surfaces exposed, whether painted or unpainted finish, shall be tied with 14 ga. soft annealed galvanized wire. Uncoated tie wire in exposed members will not be accepted.

D. Restore damaged bars to full capacity in accordance with CRSI requirements and in a manner acceptable to the Engineer.

E. Minimum Reinforcement: Where no other reinforcement is shown provide #4 @ 12 inches on center each way each face. For concrete fill or toppings, provide one layer of 6 x 6-W 1.4 x W 1.4 welded wire fabric per 6 inches of thickness.

F. Install welded wire fabric in as long lengths as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction. Securely support all mesh in its specified location.

3.4 MIXING CONCRETE

A. Ready Mixed Concrete

1. Comply with ASTM C94.
2. Add mixing water only at the batch plant. Begin the mixing operation within 30 minutes after the cement has been intermingled with the aggregates.
3. Discharge the concrete completely at the site within 1-1/2 hours after the

introduction of the cement to the aggregates. In hot weather reduce this time limit so that no stiffening of the concrete shall occur until after it has been placed.

B. Batch Mixing at Site

1. Comply with ASTM C94.
2. Excessive mixing requiring the addition of water to preserve the required consistency will not be permitted. Mix concrete to a consistency which can be readily placed without segregation.
3. Equip mixers with a device for measuring and dispensing admixtures. When required, the slump of concrete may be increased prior to placement by the use of a high range water reducing admixture.

C. Retempering: No water shall be added to the mix after the initial batching operation. Concrete which is placed after the unauthorized addition of water is subject to removal. Redosage with the superplasticizer may be done with approval of the Engineer as to methods and procedures.

D. When required, the slump of concrete as delivered to the site may be increased prior to placement by the use of a high range water reducing admixture. Dosage of super

plasticizer shall be within the guidelines established by the manufacturer and agreed to by the engineer. Alternative Mix Design Reports with the recommended site dosage(s) of super plasticizer shall be submitted prior to use.

3.5 JOINTS AND EMBEDDED ITEMS

A. Construction Joints
1. Comply with ACI 301, Section 2.2.1.
2. Form all construction joints with a shear key. Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints except as otherwise shown.

B. Expansion Joints
1. Comply with ACI 301, Section 2.2.1.4.
2. Install joint filler to allow the required dimension for sealant, as indicated. Dimensions shown on Drawings are based on an assumed design temperature of 70 deg. F. Concreting procedures shall take into account the ambient temperature range at the time of the respective operations.

C. Embedded Items
1. Comply with ACI 301, Section 2.2.1.5. For embedded items associated with structural steel, comply with AISC requirements. For embedded items associated with precast concrete, comply with PCI recommendations.
2. Accurately set anchorage devices by line and transit, and coordinate the locating of all anchorage devices to be set for the accommodation of the work of other trades.
3. Locate anchor bolts and embed plates as shown on the Drawings and on shop drawings. Obtain necessary templates from the steel and mechanical trades as required for the proper setting of anchor bolts , embed plates and other items for structural steel and mechanical equipment, as required.
4. Assist other trades in the installation of piping, pipe sleeves, conduit and similar

items where such items are to be installed in concrete. Provide frames to securely hold anchor bolts and anchorage devices in place during construction, and take care that no displacement occurs during the pouring of concrete. Under this Section furnish and set items not furnished by other trades using approved standard type items suitable for their intended purpose.

D. PVC Waterstops

1. Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions.
2. Field butt splices shall be heat fused welded using a Teflon coated thermostatically controlled waterstop splicing iron at approximately 380 degrees F. Follow approved manufacturer recommendations. Lapping of waterstop, use of adhesives, or solvents shall not be allowed.

3. Center waterstop in joint and secure waterstop in correct position using hog rings or grommets spaced at 12 inches on center along the length of the waterstop and wire tie to adjacent reinforcing steel.
4. Waterstop splicing defects which are unacceptable include, but are not limited to the following: Tensile strength less than 80 percent of parent section. Misalignment of centerbulb, ribs, and end bulbs greater than 1/16 inch. Bond failure at joint deeper than 1/16 inch or 15 percent of material thickness. Misalignment which reduces waterstop cross section more than 15 percent. Visible porosity in the weld. Bubbles or inadequate bonding. Visible signs of splice separation when cooled splice is bent by hand at a sharp angle. Charred or burnt material.

E. Bentonite Waterstops

1. Install in construction joints and at other locations indicated according to the manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.

2. Locate and support waterstops to prevent displacement.

3.6 PLACING CONCRETE

A. Preparation Before Placing: Conform to ACI 301, Section 5.3.1.
1. Testing and Inspection specified in Paragraph "Quality Control" shall be completed before concrete placement.
2. For flatwork, clean the entire formwork or deck surface of dust and dirt, loose anchors stud ferrules, and other foreign material.
3. Dampen and cool subgrades and formwork as required.
4. Instrument check all formwork for compliance with specified tolerances before concrete placement.

B. Preparation of Form Surfaces
1. Coat contact surfaces of forms with an approved, nonresidual, form-coating compound before reinforcement is placed. Do not allow excess form coating material to accumulate in forms or to come into contact with in-place concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's written instructions and recommendations.

C. Conveying

1. Comply with ACI 301, Section 5.3.2.2. and ACI 304R.
2. Provide a spout or downpipe and elephant trunk or other appropriate method to prevent concrete from falling freely through a height greater than 5 ft. Free fall in walls and columns shall not exceed 15 ft.
3. For pumped concrete, comply with ACI 304.2R. For lightweight concrete that is to be pumped, the aggregate shall be uniformly pre-wetted or pre-saturated in such a manner and to the extent recommended by the manufacturer in order to minimize loss of workability of the plastic concrete.

D. Depositing: Comply with ACI 301, Section 5.3.2.4 and ACI 304R.

1. Deposit concrete within 5 ft. of its final position in uniform layers not exceeding 18 in. No more than 30 min. shall elapse between layer placements. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.
2. Consolidate concrete to maximum density using internal vibration. Insert and withdraw vibrators vertically drawing out entrapped air and excess water. Do not use vibrators to transport concrete within forms. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix. Pay particular attention to providing adequate vibration in the vicinity of sleeves and embeds in heavily reinforced elements and other elements as required. Provide form vibrators to ensure maximum density of concrete.

E. Additional concrete at metal decking: Allow for an additional 3/8” of concrete at metal deck slabs to “fill” metal deck deflections flat between steel framing.: Comply with ACI 301, Section 5.3.2.4 and ACI 304R.

F. Metal Decking: Comply with Steel Deck Institute recommendations as regards depositing of concrete on metal decks. Shore decking as required to prevent deck deflections in excess of 3/4”.

3.7 CURING

A. Comply with ACI 301, Section 5.3.6.

B. All exposed interior slabs, not receiving a liquid densifier, and troweled slabs receiving mastic applied adhesives or “shake-on” hardeners shall be cured with the specified curing and sealing compound. Exterior slabs, sidewalks, curbs, and architectural concrete, not receiving a penetrating sealer, shall be cured with the specified clear, non-yellowing curing and sealing compound. Maximum coverage shall be 400 ft^2/gallon on steel troweled surfaces and 300 ft^2/gallon on floated or broomed surfaces for the curing/sealing compound.

C. Use the specified strippable curing compound on surfaces to be covered with finish or coating material applied directly to concrete, such as liquid densifier/sealer, waterproofing, dampproofing, membrane roofing, flooring, painting, and other coatings and finish materials. Apply in strict accordance with manufacturer’s instructions.

3.8 FORM REMOVAL

A. Do not remove forms until the concrete has thoroughly hardened and has attained sufficient strength to support its own weight and construction live loads to be placed thereon, without damage to the structure. In general, do not disturb forms for framing until the concrete has attained at least 40% of design strength for side forms and 80% of design strength for bottom forms. Be responsible for proper form removal and replace any work damaged due to inadequate maintenance or improper or premature form removal.

B. Where use of metal form ties extending to within less than 1-1/2 in. of the face of permanently exposed concrete has been unavoidable, cut off such ties at least 1-1/2 in. deep in the concrete, but not less than 72 hours after concrete has been cast. Remove forms by methods which will not spall the concrete or cause any injury whatsoever. Hammering or prying against concrete will not be permitted.

3.9 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place, and cure concrete as herein specified, to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on the Architectural, Mechanical and Structural drawings and other Contract Documents. Set anchor bolts for machines and equipment to template at correct elevations, complying with certified diagrams or templates of manufacturer furnishing machines and equipment.

3.10 PATCHING/REPAIR

A. Comply with ACI 301, Section 5.3.7.

B. Honeycombing to be immediately patched upon removal of forms. Areas with extensive honeycombing shall be brought to the attention of the Engineer and the Owner's Testing Agency.

C. Remove and replace concrete that, in the Engineer's opinion, does not satisfy the requirements of the Contract Documents if repair cannot be accomplished to the Engineer's satisfaction.

D. For exposed-to-view surfaces, blend white portland cement and standard portland cement so that, when dry, patching mortar will match color surrounding. Provide test areas at inconspicuous location to verify mixture and color match before proceeding with patching.

E. Repair isolated random cracks and single holes not over 1 in. in diameter by dry pack method. Groove top of cracks and cut out holes to sound concrete and clean of dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding compound. Mix dry pack, consisting of one part portland cement to 2-1/2 parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing. Place
dry-pack before bonding compound has dried. Compact dry pack mixture in place and finish to match adjacent concrete. Keep patched area continuously moist for not less than 72 hours.

F. All structural repairs shall be made with prior approval of the Engineer as to methods and procedures. Submit a procedural outline of the proposed repair work, including a description of materials, preparation, sequencing, etc. for the Engineer's approval.

3.11 FINISHING

A. General Requirements for Flatwork: Strike-off top surfaces of all flatwork true and level to the required tolerances. Use construction techniques such as adjustment of pour size, adjustable screeds, pre-shoring/shoring/re-shoring and other appropriate means to ensure compliance with these requirements. Camber of unshored structural steel is shown on the Drawings. Provide concrete, in addition to scheduled nominal slab thickness, to allow for the steel or formwork deflections and camber (see Section "Metal Decking") and provide finished slabs level within the specified requirements. The steel camber is calculated as 75% of the deflection due to wet weight of concrete. Assume 0.5 inch average wet weight deflection where no camber is shown or specified. Monitor and survey pour areas prior to, during and after concreting operations.

B. Flatwork Finish Tolerances: All flatwork surfaces shall be tested for flatness and levelness in accordance with the F-number system (ASTM E1155). This testing shall be complete within 48 hrs. of slab installation. In areas of shored construction, measurements shall be taken prior to removal of shores. Reports of tests shall be submitted within 72 hrs. All floors are random traffic floors. Floors shall conform to the following surface profile tolerances:

1. Troweled Finish Slabs
   Overall Floor Flatness Number = 25
   Minimum Local Floor Flatness Number = 17
   Overall Floor Levelness Number = 20 (17 for elevated slabs)
   Minimum Local Floor Levelness Number = 13

2. Other Slabs
   Overall Floor Flatness Number = 20
   Minimum Local Floor Flatness Number = 13
   Overall Floor Levelness Number = 17
   Minimum Local Floor Levelness Number = 13

C. Fill or grind completed floors as necessary to achieve specified finish tolerances. Filling, where required, shall be with a self-leveling cementitious product capable of being tapered to a feathered edge or repair topping.

1. Repair any floor section measuring below either the minimum local F_f-number or the minimum local F_l-number.
2. Repair any floor where the entire tested installation measures less than the specified overall values.

D. Float Finish: Place, consolidate, strike off and level concrete slab to proper elevation. After the concrete has stiffened sufficiently to permit the operation, and water sheen has disappeared, the surface shall be floated, at least twice, to a uniform sandy texture. Provide a float finish for slab surfaces scheduled to receive the following:

1. Ceramic tile (except adhesive-set).
2. Floor topping.
3. Concrete fill.

E. Troweled Finish: After the surface has received a float finish, the concrete shall be troweled at least twice to a smooth dense finish. Do the second troweling after the concrete has become so hard that no mortar will adhere to the edge of the trowel, and exert heavy pressure to thoroughly compact the surface. Leave floors with a smooth, hard finish free of blemishes and true to the maximum flatness tolerance specified. Trowel finish surfaces scheduled to receive the following:

1. Resilient flooring.
2. Adhesive-set ceramic tile.
3. Carpeting.
4. Where no other finish is specified.

Note areas requiring “quick-dry” concrete.

3.12 CEMENT FILL

A. For steel pan-type stairs and platforms install cement fill on a continuous wire mesh of not less than 14 ga. welded wire fabric, 2 in. square, supported approximately 1/2 in. above the bottom of pans. Screed cement fill level and finish with wood float.

B. After screeding the cement finish level, permit it to stand until it will bear the weight of workmen standing on boards. At this time the abrasive aggregate, having previously been soaked in clean water for about ten minutes, shall be sprinkled uniformly on the surface and immediately wood floated into the cement finish.

3.13 LIQUID SEALER/DENSIFIER FINISH

A. Apply this compound on exposed interior floors subjected to vehicular abrasion and shake on hardener slabs as indicated on the drawings. Application shall be made in strict accordance with the directions of the manufacturer and just prior to completion of construction. Spray, squeegee or roll on liquid densifier to clean, dry concrete surface.

The liquid should be scrubbed into the surface with a mechanical scrubber. Keep the surface wet with the densifier during the application process. When the product thickens, but not more than 60 minutes after initial application, the surface shall then be squeezed or vacuumed to remove all excess liquid

1. Exposed in the finished work.
2. To receive carpeting.
3. As noted elsewhere in the Contract Documents.

3.14 GROUTING

A. Mix grout in accordance with the approved manufacturer's instructions to a consistency which will permit placement. Place grout so as to ensure complete bearing and elimination of air pockets.

B. Where high fluidity and/or increased placing time is required, use the specified high flow grout. This grout shall be used for all base plates larger than 10 square feet.

END OF SECTION 03 30 00

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Cast-in-place architectural concrete including form facings, reinforcement accessories, concrete materials, concrete mixture design, placement procedures, and finishes.
2. The requirements of this Section complement Section 03 30 00, CAST-IN-PLACE CONCRETE; and apply to architectural concrete as specified and as indicated on Drawings.
   a. Work shall include, but not be limited to, stairwell walls and exposed columns at Lower Level.

B. Related Work: The following items are not included in this Section and will be performed under the designated Sections:

1. Section 03 30 00 - CAST-IN-PLACE CONCRETE for formwork; material, fabrication, and installation requirements for steel reinforcement; and field quality control.
2. Section 07 92 00 - JOINT SEALANTS for elastomeric joint sealants in contraction and other joints in cast-in-place architectural concrete.

1.3 DEFINITIONS

A. Cast-in-Place Architectural Concrete: Formed concrete that is exposed to view on surfaces of completed structure or building and that requires special concrete materials, formwork, placement, or finishes to obtain specified architectural appearance.

B. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

C. Design Reference Sample: Sample designated by Architect in the Contract Documents that reflects acceptable surface quality and appearance of cast-in-place architectural concrete.

D. Reveal: Projection of coarse aggregate from matrix or mortar after completion of exposure operations.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Description of Methods and Sequence of Placement. For each type of specially-finished concrete provide description of methods and sequence of placement.

C. Certificates: Prior to installation submit copies of a signed affidavit from the manufacturer of the coloring product stating that coloring product to be used in concrete is compatible with the concrete mix and type to which it will be combined, and that no adverse affects will occur to the workability, setting, or strength of concrete.

D. Manufacturer's Review: Submit written signed statement, that Contract Documents have been reviewed by qualified representatives of the materials manufacturer, and that materials and system to be used for floor finish are proper and adequate for the applications shown.

E. Manufacturer's Data: Submit manufacturer's specifications and installation instructions for all products in concrete floor finish, including certifications and other data as may be required to show compliance with the Contract Documents.

F. Substrate Acceptability: Submit a certified statement issued by the manufacturer of concrete floor finish materials and countersigned by installer, attesting that surfaces designated to receive concrete floor finish are satisfactory warranty requirements. Application of materials will be construed as acceptance of surfaces.

G. Statement of Supervision: Submit signed statement signed that field supervision by manufacturer's representative was sufficient to ensure proper application of materials and that the installation is acceptable to manufacturer.

H. Samples for Verification: Architectural concrete samples, cast vertically, approximately 18 by 18 by 2 inches, of finishes, colors, and textures to match design reference sample. Include Sample sets showing the full range of variations expected in these characteristics.

1.5 QUALITY ASSURANCE

A. Finish Objective Samples. If samples are placed on display in the office of the Architect, to describe finish objectives, such samples are hereby made part of these Specifications to the degree that the samples exhibit the required color, texture and surface finish requirements. Such samples, if provided, are provided for bidding purposes only; the actual mix components, forming, placing, and finishing procedures and requirements shall be as determined by acceptable preconstruction mock-ups.

B. Preconstruction Conference. Attend a preconstruction conference prior to the start of architectural concrete construction as directed by the Architect. Discussion will include the following:

1. The Contractor's program to obtain the specified quality of architectural concrete.
2. The procedures and methods for construction of preconstruction mock-ups specified herein.

C. Preconstruction Mock-up Panels or Areas:

1. General:
   a. Schedule mock-up casting for acceptance 30 days prior to casting of architectural concrete surfaces represented by the mock-ups.

b. Locate mock-up panels in non-public areas acceptable to the Architect. Brace panels as required for safety.
c. Continue to cast mock-ups until acceptable mock-ups are produced. Accepted mock-ups shall be the standard for color, texture, and workmanship for the work.
d. Mock-up sequence of forming, placing, form removal, curing and finishing shall be reviewed and accepted by the Architect.
e. Mock-up formwork shall be inspected and accepted by the Architect before placing of concrete.
f. Use the same concrete mixes and placement procedures, accepted in mock-ups, in the final work, unless otherwise directed by the Architect.
g. Protect accepted mock-ups from damage until completion and acceptance of the work represented by the mock-up.
h. Remove mock-up panels from site at completion of Project, as directed by the Architect.

2. Construct mock-up panels or areas as indicated to demonstrate the ability to cast architectural concrete to achieve shapes, color, and textured finishes required. Mock-ups shall include or meet the following requirements:
a. Provide full scale mock-up panels and areas.
b. Provide mock-ups simulating actual design and execution conditions for concrete mix materials, reinforcement, formwork, placing sequence, form removal, curing, finishing, and methods and materials of stain removal and correction of defective work.
c. On mock-ups where directed by the Architect, provide minimum of five variation of mix color to be used in the repair of defective work, in order to determine acceptable color and texture match.
d. Demonstrate, on the mock-ups, materials and methods of plugging tie-holes unless tie holes are indicated to be left in place.
e. Demonstrate in the construction of the mock-up formwork the sealer material, form release agent, and curing materials and methods to be used.

D. Source of Materials. Utilize the same source, stock or brand of concrete materials for each class or mix of architectural concrete. Do not interchange materials or mixes until an additional mock-up shows that uniformity in finish, texture, and color, as compared to original mock-up will be maintained. If necessary, obtain and stockpile materials in sufficient quantity to ensure continuity and uniformity.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's unopened containers identified with brand, type, grade, date of manufacture, class, lot number, and other qualifying information.

B. Store materials in original sealed containers, in dry enclosed storage area, within temperature range recommended by manufacturer.

1.7 JOB CONDITIONS

A. Maintain manufacturer's current installation instructions at Project site.

B. Maintain interior building area above 50°F before, during, and after installation of architectural concrete until structure and subfloor temperatures are stabilized.

C. Provide and maintain adequate ventilation until concrete cures completely.

1.8 PROTECTION

A. Protect adjacent surfaces and repair, restore, or replace soiled or damaged in performance of special architectural concrete finish work.

1.9 GUARANTEE

A. Warrant work of this Section for five years from date of Substantial Completion; correct defects upon written notice at no additional cost to Owner. Warranty shall be signed by installer and materials manufacturer.

PART 2 - PRODUCTS

2.1 CONCRETE

A. Except as otherwise indicated, concrete materials including aggregates, Portland cement, and water shall conform to Section 03 30 00, CAST-IN-PLACE CONCRETE.

2.2 ARCHITECTURAL CONCRETE FOR VERTICAL WALLS

A. Concrete: Color of concrete shall be normalweight concrete without color additive; color for architectural concrete shall be uniform throughout area designated.

B. Formwork Ties: Formwork tie spacing and location of ties shall be in a consistent pattern or layout acceptable to the Architect. Tie design shall be acceptable to the Architect.

C. Formwork Materials: Steel faced or fiberglass faced formwork as required to produce a smooth form finish acceptable to the Architect.

1. Architectural Concrete Finish No. 1 - Smooth Form Finish with Smooth Rubbed Finish:
   a. Formwork: Smooth form concrete using steel forms or fiberglass forms. Joints in formwork shall be sealed. Form ties shall be uniformly placed accurately located in accordance with layout approved by the Architect.
   b. Finish Description/Procedure: Rubbing shall be produced on newly hardened concrete no later than the day following form removal. When required by the Architect to correct work done in an incorrect manner or in a manner not as specified, rubbing shall commence within 48 hours of notification by the Architect. Surfaces to be rubbed shall be wetted and rubbed with carborundum brick or other approved abrasive of equal quality until uniform color and texture are produced, without applying any cement, grout or other coating. Rubbing will not be permitted when the air temperature is expected to fall below 40 degrees F. Rubbing may be performed by use of approved power equipment and tools, providing that the operational procedures shall produce the same desired effects as hand rubbing.
   c. Cement Color: Color meeting approved mock-up. In order to achieve the desired color/finish of concrete, concrete mix may required the use of a white cement or control of color of aggregates may be required.

PART 3 - EXECUTION

3.1 PLACING CONCRETE

A. Except as modified herein, concrete shall be placed in accordance with Section 03 30 00, CAST-IN-PLACE CONCRETE.

1. Consolidate vertical colored concrete in lifts 1 ft. or less in depth and vibrate twice that normally required by decreasing the spacing, depth, and time to ensure uniform color.
2. There shall be no honeycombing or segregated aggregates in concrete exposed to view in areas identified as Architectural Concrete.

B. Finish: Provide the following finish for vertical Architectural Concrete:

1. Smooth form finish with smooth rubbed finish. Rubbing shall be produced on newly hardened concrete no later than the day following form removal. When required by the Architect to correct work done in an incorrect manner or in a manner not as specified, rubbing shall commence within 48 hours of notification by the Architect. Surfaces to be rubbed shall be wetted and rubbed with carborundum brick or other approved abrasive of equal quality until uniform color and texture are produced, without applying any cement, grout or other coating. Rubbing will not be permitted when the air temperature is expected to fall below 40 degrees F. Rubbing may be performed by use of approved power equipment and tools, providing that the operational procedures shall produce the same desired effects as hand rubbing.

3.2 PROTECTION FROM AND REMOVAL OF STAINS

A. On mock-up where directed by the Architect, demonstrate methods of rust stain removal in accordance with recommendations of ACI 303 Chapter 10, Section 10.4.

B. Comply with requirements of Section 03 30 00, CAST-IN-PLACE CONCRETE, and procedures used in construction of accepted mock-ups.

END OF SECTION 03 33 00

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Concrete sealer at custodial closets, storage rooms, utility rooms, and mechanical rooms as scheduled on the Room Finish Schedule on the Architectural Drawings.
2. Cementitious microtopping overlay and integral color finish system at Corridor floors as scheduled on the Room Finish Schedule on the Architectural Drawings.

B. Sustainable Design Intent: Comply with project requirements intended to achieve certification, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13 - SUSTAINABLE DESIGN AND LEED REQUIREMENTS, for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 03 30 00 - CAST-IN-PLACE CONCRETE for concrete substrates.
2. Section 09 90 00 - PAINTING AND COATINGS for paints applied to concrete substrates.

1.3 SUBMITTALS

A. Product Data: For each finish system indicated. Include primers.

1. Material List: An inclusive list of required system materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
2. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.

B. LEED Submittals:

1. Credit IEQ 4.2: Manufacturers' product data for interior paints and coatings, including printed statement of VOC content.

C. Samples for Verification: For each color and material to be applied, with texture to simulate actual conditions, on representative Samples of the actual substrate.

1. Provide stepped Samples, defining each separate coat, including primers. Use representative colors when preparing Samples for review. Resubmit until required sheen, color, and texture are achieved.
2. Provide a list of materials and applications for each coat of each Sample. Label each Sample for location and application.
3. Submit two eight inch by 12 inch Samples for each type of finish coating for Architect's review of color and texture only.

D. Qualification Data: For Applicator.

E. Maintenance Data: For finish flooring to include in maintenance manuals. Include Product Data for floor-care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.4 QUALITY ASSURANCE

A. Applicator Qualifications: A firm or individual experienced in applying concrete finishes similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.

1. Applicator shall be trained and certified by finish system manufacturer with a minimum of 5 years documented experience with projects of similar size and scope.

B. Source Limitations: Obtain system components, including primers, for each coating system from the same manufacturer as the finish coats.

C. Freestanding Mock-Ups: Refer to Division 01 for requirements.

D. Preinstallation Conference: Conduct conference at Project site. Comply with requirements in Division 01.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:

1. Product name or title of material.
2. Product description (generic classification or binder type).
3. Manufacturer's stock number and date of manufacture.
4. Contents by volume, for pigment and vehicle constituents.
5. Thinning instructions.
6. Application instructions.
7. Color name and number.
8. VOC content.

B. Deliver materials to site at least 24 hours before start of work.

C. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F. Maintain storage containers in a clean condition, free of foreign materials and residue.

1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily.

1.6 PROJECT CONDITIONS

A. Apply waterborne finish only when temperatures of surfaces to be finished and surrounding air are between 50 and 90 deg F.

B. Apply solvent-thinned finish only when temperatures of surfaces to be finished and surrounding air are between 45 and 95 deg F.

C. Close areas to traffic during finish system application and, after application, for time period recommended in writing by manufacturer.

PART 2 - PRODUCTS

2.1 CONCRETE SEALER

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1. Concrete Sealer:
   a. Curecrete Chemical Company, Inc.
   b. Euclid Chemical Company, Inc.
   c. W.R. Grace Company.
   d. L & M Construction Chemicals

B. Concrete Sealer: Water-based, chemically reactive transparent sealer for concrete, formulated to penetrate concrete surface to control curing, increase hardness and provide a permanent seal. Sealer shall react chemically with salts in the concrete to prevent release of concrete dust and neutralize alkali in the concrete.

C. Performance Criteria:

1. Abrasion, per ASTM C779: Minimum 30% increase in abrasion resistance.
2. Hardness:
   a. Increase in compressive strength of surface, per ASTM C39: minimum 40% increase in compressive strength at 7 days and 35% increase at 28 days over strength of untreated samples.
   b. Impact resistance, per ASTM C805-Schmidt hammer: Minimum 13% increase in impact resistance.
3. Weathering, per ASTM G23-81: No measurable adverse effect from ultraviolet light, nor from water spray.

D. Basis-of-Design Product: Curecrete Chemical co., Inc., Ashford Formula.

2.2 CEMENTITIOUS MICROTOPPING OVERLAY, INTEGRAL COLORS AND CLEAR PROTECTIVE COATS

A. Basis of Design: Pientimento and Colorfast, Duraamen Engineered Products.

1. Color - Basis-of-Design:
   a. PC-1 / Cementitious Micro-Top Dyed Over-Lay: Duraamen Pentimento/Colorfast, Green.
   b. PC-2 / Cementitious Micro-Top Dyed Over-Lay: Duraamen Pentimento/Colorfast, Forest Green.
   c. PC-3 / Cementitious Micro-Top Dyed Over-Lay: Duraamen Pentimento/Colorfast, Turquoise.

B. Cementitious Microtopping Overlay: PENTIMENTO – Portland cement based acrylic modified concrete supplied by Düraamen Engineered Products Inc. Pentimento shall be integrally colored with powdered pigments, chemically stained or dyed after 24 hours of its installation.

1. Application: Apply Pentimento at a thickness of 1/8” using a ‘Turbo Roller’ which ensures that it is applied at exactly 1/8” thickness.
2. Priming: Prime the substrates with CP1000, pure acrylic copolymer primer/activator as per manufacturer’s instructions. NOTE: Installer to obtain written specific instructions for priming various substrates from the manufacturer.
3. Compressive Strength, ASTM C109: 51000psi
4. Working Time at 700F: 20 minutes
5. Set Time: ASTM C 191 at 700F, Initial Set – 1 to 1.5hr / Final Set: 2 to 3hr

C. Integral Powder Color: Colorfast, synthetic iron oxide pigments and admixutres.

1. PC-1: Duraamen Colorfast, Green.
2. PC-2: Duraamen Colorfast, Forest Green.
3. PC-3: Duraamen Colorfast, Turquoise.
4. Final colors to match Architect’s selection.

D. Protective Top Coats: Manufactured by Düraamen Engineered Products Inc.

1. Primer: Perdüre E32 – Water based epoxy primer
2. Top Coat: Perdüre U50(HS), water based polyurethane

E. Accessories:

1. Primer: Päram Super Primer and CP1000
2. Moisture Vapor Control: Perdüre MVT
3. Crack Repair: Perdüre ECF
4. Joint Filler: Perdüre EJF

F. Mixing: Mix materials according to manufacturer's written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for conditions affecting performance of concrete floor finish system.

1. Verify that base concrete slabs comply with surface requirements specified in Section 03 30 00 - CAST-IN-PLACE CONCRETE.

2. Verify that base slabs are visibly dry and free of moisture. Test for capillary moisture by the plastic sheet method according to ASTM D 4263.

B. Proceed with application only after unsatisfactory conditions have been corrected.

3.2 CONCRETE SEALER APPLICATION

A. Apply sealer to saturate concrete surface, in strict accordance with manufacturer's recommendations. Sealer may be spray-applied, or poured and broomed.

B. Surface Preparations: Sweep all areas to be treated with a fine bristle broom or scrub. Hose off with water and allow to dry.

C. Application to New Concrete:

1. Apply sealer following concrete finishing operation, as soon as the surface is firm enough to walk on, and before hairline checking and temperature cracking begin. Keep the entire surface wet with sealer for 30 minutes.
2. When sealer becomes slippery, lightly mist the surface with water.
3. When the sealer again becomes slippery, thoroughly flush the entire surface with water and squeegee the surface completely dry to remove all surface alkali or sealer residue.

D. Application to Cured Concrete:

1. Apply sealer to entire surface to saturation. Keep the entire surface wet with sealer for 30 minutes.
2. If, after 30 to 40minutes, most of the sealer has been absorbed into the surface, broom or squeegee any excess material from all low spots and puddles so that all remaining sealer is entirely absorbed into the concrete or totally removed from the surface..
3. If, after 30 to 40minutes, most of the sealer is still on the surface, wait until it becomes slippery, then thoroughly flush the entire surface with water and squeegee the surface completely dry to remove all surface alkali or sealer residue.

E. Cleaning: Wash or wet mop sealed concrete floor with a neutral or high pH detergent.

3.3 CEMENTITIOUS MICROTOPPING OVERLAY FLOOR FINISH SYSTEM APPLICATION

A. General: Commence application in the presence of the manufacturer's technical representative, after concrete has been in place a minimum of 45 days. Apply concrete floor finish system in strict accordance with manufacturer's recommendations and instructions.

B. Preparation: Concrete substrates:

1. Clean area and remove unsound concrete grease, oil, paint and any other foreign materials that will inhibit performance.
2. Substrate shall be stable, solid and structurally sound.
3. After sanding and cleaning the substrate, test for MVER (moisture vapor emission rate – reference ASTM F 1869).
4. Repair deep area, holes and non-moving cracks with Perdüre ECF.

C. Priming: Two or more applications of primer may be required on porous substrates. If the primer turns clear in approximately 30 minutes, then additional coats are needed. Allow the first

coat to dry before applying additional coats. Primed floor shall be covered with Pentimento within 8-10 hours, or primer shall be reapplied. Protect primed substrate from foot traffic. Install a bond breaker where vertical surfaces meet the new topping.

D. Mix proportions and methods shall be in strict accordance with product manufacturer recommendations.

E. Application of cementitious microtopping overlay:

1. Apply one coat of Pentimento at exactly 1/8" thickness using 'Turbo Roller' integrally colored with Colorfast as per dosage determined after the site mock-ups or samples or chemically stained with Patinaetch, acid stains.
2. Install in accordance with manufacturer's instructions.

F. Sealing:

1. The sealing process should not begin before 24 hours after completion of the pour. There must be NO foot traffic on the poured floor prior to installation of the sealer.
2. As per manufacturers' instructions, apply 1 coat of Perdüre e32 – water based epoxy primer and allow it to dry for at least 6 hours before applying the Polyurethane top coat.
3. Apply two coats of Perdüre U50(HS) (gloss) as per manufacturer's instructions.
4. Surface and air temperature, humidity and air-movement conditions must be as specified in manufacturer's technical data sheets.

3.4 PROTECTING AND CURING

A. General: Protect freshly placed concrete floor finish system from premature drying and excessive cold or hot temperatures.

B. Cover all concrete finishes with construction paper or plywood to protect them from construction traffic.

3.5 REPAIRS

A. Defective Finish System: Repair and patch defective concrete floor finish system areas, including areas that have not bonded to concrete substrate.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing Services: Testing and inspecting of completed applications of concrete floor finish systems shall take place in successive stages prior to grinding and polishing, in areas of extent and using methods as follows:

1. Revise frequency of sampling in first subparagraph below to suit Project. Because there are no industry recommendations, frequency below is an example only. Cubes are 2 inches square.
2. Sample Sets: At point of placement, a set of 3 molded-cube samples shall be taken from the finish system mix for the first 1000 sq. ft., plus 1 set of samples for each subsequent 5000 sq. ft. of finish system, or fraction thereof, but not less than 6 samples for each

day's placement. Samples shall be tested according to ASTM C 109 for compliance with compressive-strength requirements.

3. Concrete floor finish system shall be tested for delamination by dragging a steel chain over the surface.
4. Concrete floor finish system shall be tested for compliance with surface flatness and levelness tolerances.

C. Remove and replace applications of concrete floor finish system where test results indicate that it does not comply with specified requirements.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

END OF SECTION

SECTION 03 45 00

ARCHITECTURAL PRECAST CONCRETE

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Architectural precast concrete cornice, sills, moldings, and custom bas-relief wall and canopy panels

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 03 30 00 - CAST-IN-PLACE CONCRETE for installing connection anchors in concrete.
2. Section 05 12 00 - STRUCTURAL STEEL FRAMING for furnishing and installing connections attached to structural-steel framing.
3. Section 05 50 00 - METAL FABRICATIONS for miscellaneous steel shapes.

1.3 DEFINITION

A. Design Reference Sample: Sample of approved architectural precast concrete color, finish, and texture, preapproved by Architect.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design architectural precast concrete units and connections, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Provide architectural precast concrete units and connections capable of withstanding the following design loads within limits and under conditions indicated.

1. Wind Loads: As required by Code. Refer to Structural Drawings for design loads.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. LEED Submittal:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.

a. Include statement indicating costs for each product having recycled content.

C. Design Mixtures: For each precast concrete mixture. Include compressive strength and water-absorption tests.

D. Shop Drawings: Delegated design, detail fabrication and installation of architectural precast concrete units. Indicate locations, plans, elevations, dimensions, shapes, and cross sections of each unit. Indicate joints, reveals, and extent and location of each surface finish. Indicate details at building corners.

1. Indicate separate face and backup mixture locations and thicknesses.
2. Indicate welded connections by AWS standard symbols. Detail loose and cast-in hardware and connections.
3. Design and indicate locations, tolerances, and details of anchorage devices to be embedded in or attached to structure or other construction.
4. Indicate locations, extent, and treatment of dry joints if two-stage casting is proposed.
5. Include plans and elevations showing unit location and sequence of erection for special conditions.
6. Indicate location of each architectural precast concrete unit by same identification mark placed on panel.
7. Indicate relationship of architectural precast concrete units to adjacent materials.
8. Design Modifications: If design modifications are proposed to meet performance requirements and field conditions, submit design calculations and Shop Drawings. Do not adversely affect the appearance, durability, or strength of units when modifying details or materials and maintain the general design concept.
9. Delegated Design: Comprehensive engineering analysis signed and sealed by the qualified professional engineer responsible for its preparation. Show governing panel types, connections, and types of reinforcement, including special reinforcement. Indicate location, type, magnitude, and direction of loads imposed on the building structural frame from architectural precast concrete.

E. Samples: For each type of finish indicated on exposed surfaces of architectural precast concrete units, in sets of 3, illustrating full range of finish, color, and texture variations expected; approximately 12 by 12 by 2 inches.

1. When other faces of precast concrete unit are exposed, include Samples illustrating workmanship, color, and texture of backup concrete as well as facing concrete.

F. Welding certificates.

G. Qualification Data: For Installer and fabricator

H. Material Test Reports: For aggregates.

I. Material Certificates: Include statements of material properties indicating compliance with requirements including compliance with standards and type designations within standards. Provide for each type and size of the following:

1. Cementitious materials.
2. Reinforcing materials and prestressing tendons.
3. Admixtures.
4. Bearing pads.
5. Structural-steel shapes and hollow structural sections.

J. Source quality-control test reports.

K. Field quality-control test and special inspection reports.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A precast concrete erector who has retained a "PCI-Certified Field Auditor" to conduct a field audit of a project in same category as this Project before erection of precast concrete and who can produce an Erectors' Post-Audit Declaration.

B. Fabricator Qualifications: A firm that assumes responsibility for engineering architectural precast concrete units to comply with performance requirements. This responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.

1. Participates in PCI's plant certification program and is designated a PCI-certified plant for Group A, Category A1 - Architectural Cladding and Load Bearing Units.

C. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

D. Design Standards: Comply with ACI 318 and design recommendations of PCI MNL 120, "PCI Design Handbook - Precast and Prestressed Concrete," applicable to types of architectural precast concrete units indicated.

E. Quality-Control Standard: For manufacturing procedures and testing requirements, quality-control recommendations, and dimensional tolerances for types of units required, comply with PCI MNL 117, "Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products."

F. Welding: Qualify procedures and personnel according to AWS D1.1/D.1.1M, "Structural Welding Code - Steel"; and AWS D1.4, "Structural Welding Code - Reinforcing Steel."

G. Preconstruction Mock-up Panels:

1. Schedule minimum 6’ wide by full height mock-up casting of each panel casting for each panel type for acceptance 30 days prior to casting of architectural concrete surfaces represented by the mock-ups. Confirm mock-up panels types and extent of work to be represented by the mock-ups with the Architect prior to fabrication of the mock-ups. Refer to Architectural Exterior Elevations on the Drawings for extent of mock-ups.

2. Locate mock-up panels in non-public, secure areas acceptable to the University representative, DCS project Manager, and the Architect. Brace panels as required for support and safety.
3. Continue to cast mock-ups until acceptable mock-ups are produced. Accepted mock-ups shall be the standard for color, texture, pattern, and workmanship for the work.
4. Mock-up sequence of forming, placing, form removal, curbing, and finishing shall be reviewed by the Architect.
5. Mock-up formwork shall be inspected and accepted by the Architect before placing of concrete.
6. Use the same concrete mixes and placement procedures, accepted in the mock-ups, in the final work unless noted otherwise by the Architect.
7. Repair surface defects using materials and methods acceptable to the Architect until satisfactory results are obtained.
8. Intentionally damage a portion of the mock-up and repair to demonstrate materials, workmanship, finish, and final appearance of repair.
9. Protect accepted mock-up from damage until completion and acceptance of the work represented by the mock-up.
10. Remove mock-up panels from site at completion of the Project, as directed by the Architect.

H. Range Samples: After mock-up panel approval and before fabricating architectural precast concrete units, produce a minimum of 5 sets of samples, approximately 3 sq. ft. in area, representing anticipated range of each color and texture on Project's units. Following range sample, maintain one set of samples at Project site and remaining sample sets at manufacturer's plant as color and texture approval reference.

I. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01. Agenda shall include protection of air barrier membrane during construction.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver architectural precast concrete units in such quantities and at such times to limit unloading units temporarily on the ground.

B. Support units during shipment on nonstaining shock-absorbing material.

C. Store units with adequate dunnage and bracing and protect units to prevent contact with soil, to prevent staining, and to prevent cracking, distortion, warping or other physical damage.

D. Place stored units so identification marks are clearly visible, and units can be inspected.

E. Handle and transport units in a position consistent with their shape and design in order to avoid excessive stresses which would cause cracking or damage.

F. Lift and support units only at designated points shown on Shop Drawings.

1.8 PROJECT CONDITIONS

A. Protection of Air Barrier Membrane: During construction, protect air barrier membrane from penetrations which allow air to pass through air barrier assemblies. Engage original installer to repair damage promptly using identical materials and methods of installation, and to the satisfaction of the Architect.

1.9 SEQUENCING

A. Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction without delaying the Work. Provide locations, setting diagrams, templates, instructions, and directions, as required, for installation.

PART 2 - PRODUCTS

2.1 MOLD MATERIALS

A. Molds: Rigid, dimensionally stable, non-absorptive material, warp and buckle free, that will provide continuous and true precast concrete surfaces within fabrication tolerances indicated; nonreactive with concrete and suitable for producing required finishes.

1. Mold-Release Agent: Commercially produced liquid-release agent that will not bond with, stain or adversely affect precast concrete surfaces and will not impair subsequent surface or joint treatments of precast concrete.

B. Form Liners: Units of face design, texture, arrangement, and configuration indicated. Furnish with manufacturer's recommended liquid-release agent that will not bond with, stain, or adversely affect precast concrete surfaces and will not impair subsequent surface or joint treatments of precast concrete.

C. Surface Retarder: Chemical set retarder, capable of temporarily delaying final hardening of newly placed concrete mixture to depth of reveal specified.

2.2 REINFORCING MATERIALS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

C. Epoxy-Coated Reinforcing Bars: ASTM A 775/A 775M epoxy coated.

D. Epoxy-Coated-Steel Wire: ASTM A 884/A 884M, Class A coated, deformed, flat sheet, Type 1 bendable coating.

E. Supports: Suspend reinforcement from back of mold or use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 117.

2.3 CONCRETE MATERIALS

A. Each material used in architectural precast concrete shall be from a single source and shall consistently match throughout the work.

B. Color and texture of all architectural precast to match Buley Library and approved sample.

C. Portland Cement: ASTM C 150, Type I or Type III, gray, unless otherwise indicated.

D. Supplementary Cementitious Materials:

1. Fly Ash: ASTM C 618, Class C or F, with maximum loss on ignition of 3 percent.
2. Metakaolin Admixture: ASTM C 618, Class N.
3. Silica Fume Admixture: ASTM C 1240, with optional chemical and physical requirement.
4. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

E. Normal-Weight Aggregates: Except as modified by PCI MNL 117, ASTM C 33, with coarse aggregates complying with Class 5S. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.

1. Face-Mixture-Coarse Aggregates: Selected, hard, and durable; free of material that reacts with cement or causes staining; to match approved selected finish sample.

a. Gradation: To match approved design reference sample.

2. Face-Mixture-Fine Aggregates: Selected, natural or manufactured sand of same material as coarse aggregate, unless otherwise approved by Architect.

F. Coloring Admixture: ASTM C 979, synthetic or natural mineral-oxide pigments or colored water-reducing admixtures, temperature stable, and nonfading.

G. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 117.

H. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.

2.4 STAINLESS-STEEL CONNECTION MATERIALS

A. Stainless-Steel Plate: ASTM A 666, Type 304, of grade suitable for application.

B. Stainless-Steel Bolts and Studs: ASTM F 593, Alloy 304 or 316, hex-head bolts and studs; stainless-steel nuts; and flat, stainless-steel washers.

1. Lubricate threaded parts of stainless-steel bolts with an antiseize thread lubricant during assembly.

C. Stainless-Steel-Headed Studs: ASTM A 276, with minimum mechanical properties of PCI MNL 117, Table 3.2.3.

2.5 BEARING PADS

A. Provide one of the following bearing pads for architectural precast concrete units as recommended by precast fabricator for application:

1. Elastomeric Pads: AASHTO M 251, plain, vulcanized, 100 percent polychloroprene (neoprene) elastomer, molded to size or cut from a molded sheet, Type A durometer hardness of 50 to 70, ASTM D 2240, minimum tensile strength 2250 psi, ASTM D 412.
2. Random-Oriented, Fiber-Reinforced Elastomeric Pads: Preformed, randomly oriented synthetic fibers set in elastomer. Type A durometer hardness of 70 to 90, ASTM D 2240; capable of supporting a compressive stress of 3000 psi with no cracking, splitting, or

delaminating in the internal portions of pad. Test one specimen for every 200 pads used in Project.

3. Cotton-Duck-Fabric-Reinforced Elastomeric Pads: Preformed, horizontally layered cotton-duck fabric bonded to an elastomer; Type A durometer hardness of 80 to 100, ASTM D 2240; complying with AASHTO's "AASHTO Load and Resistance Factor Design (LRFD) Bridge Design Specifications, Division II, Section 18.10.2, or with MIL-C-882E.
4. Frictionless Pads: Tetrafluoroethylene (Teflon), glass-fiber reinforced, bonded to stainless or mild-steel plate, of type required for in-service stress.
5. High-Density Plastic: Multimonomer, nonleaching, plastic strip.

2.6 ACCESSORIES

A. Reglets: Stainless steel, Type 302 or 304, felt or fiber filled, or with face opening of slots covered.

B. Precast Accessories: Provide clips, hangers, plastic or steel shims, and other accessories required to install architectural precast concrete units.

2.7 GROUT MATERIALS

A. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C 1107, Grade A for drypack and Grades B and C for flowable grout and of consistency suitable for application within a 30-minute working time.

2.8 CONCRETE MIXTURES

A. Prepare design mixtures for each type of precast concrete required.

B. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast plant personnel at architectural precast concrete fabricator's option.

C. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 318 or PCI MNL 117 when tested according to ASTM C 1218/C 1218M.

D. Normal-Weight Concrete Mixtures: Proportion face and backup mixtures by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:

1. Compressive Strength (28 Days): 5000 psi minimum.
2. Maximum Water-Cementitious Materials Ratio: 0.45.

E. Water Absorption: 6 percent by weight or 14 percent by volume, tested according to PCI MNL 117.

F. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 117.

G. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.

2.9 MOLD FABRICATION

A. Molds: Accurately construct molds, mortar tight, of sufficient strength to withstand pressures due to concrete-placement operations and temperature changes and for prestressing and detensioning operations. Coat contact surfaces of molds with release agent before reinforcement is placed. Avoid contamination of reinforcement and prestressing tendons by release agent.

1. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and supports to maintain stability of liners during concrete placement. Coat form liner with form-release agent.

B. Maintain molds to provide completed architectural precast concrete units of shapes, lines, and dimensions indicated, within fabrication tolerances specified.

1. Form joints are not permitted on faces exposed to view in the finished work.
2. Edge and Corner Treatment: Uniformly chamfered.

2.10 FABRICATION

A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware, and secure in place during precasting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.

1. Weld-headed studs and deformed bar anchors used for anchorage according to AWS D1.1/D1.1M and AWS C5.4, "Recommended Practices for Stud Welding."

B. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing architectural precast concrete units to supporting and adjacent construction.

C. Cast-in reglets, slots, holes, and other accessories in architectural precast concrete units as indicated on the Contract Drawings.

D. Cast-in openings larger than 10 inches in any dimension. Do not drill or cut openings or prestressing strand without Architect's approval.

E. Reinforcement: Comply with recommendations in PCI MNL 117 for fabricating, placing, and supporting reinforcement.

1. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond with concrete. When damage to epoxy-coated reinforcing exceeds limits specified in ASTM A 775/A 775M, repair with patching material compatible with coating material and epoxy coat bar ends after cutting.
2. Accurately position, support, and secure reinforcement against displacement during concrete-placement and consolidation operations. Completely conceal support devices to prevent exposure on finished surfaces.
3. Place reinforcement to maintain at least 3/4-inch minimum coverage. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.

4. Place reinforcing steel and prestressing strand to maintain at least 3/4-inch minimum concrete cover. Increase cover requirements for reinforcing steel to 1-1/2 inches when units are exposed to corrosive environment or severe exposure conditions. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.
5. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh spacing and wire tie laps, where required by design. Offset laps of adjoining widths to prevent continuous laps in either direction.

F. Reinforce architectural precast concrete units to resist handling, transportation, and erection stresses.

G. Prestress tendons for architectural precast concrete units by either pretensioning or post-tensioning methods. Comply with PCI MNL 117.

1. Delay detensioning or post-tensioning of precast, prestressed architectural concrete units until concrete has reached its indicated minimum design release compressive strength as established by test cylinders cured under same conditions as concrete.
2. Detension pretensioned tendons either by gradually releasing tensioning jacks or by heat-cutting tendons, using a sequence and pattern to prevent shock or unbalanced loading.
3. If concrete has been heat cured, detension while concrete is still warm and moist to avoid dimensional changes that may cause cracking or undesirable stresses.
4. Protect strand ends and anchorages with bituminous, zinc-rich, or epoxy paint to avoid corrosion and possible rust spots.

H. Comply with requirements in PCI MNL 117 and requirements in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.

I. Place face mixture to a minimum thickness after consolidation of the greater of 1 inch or 1.5 times the maximum aggregate size, but not less than the minimum reinforcing cover specified.

J. Place concrete in a continuous operation to prevent seams or planes of weakness from forming in precast concrete units.

1. Place backup concrete mixture to ensure bond with face-mixture concrete.

K. Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air on surfaces. Use equipment and procedures complying with PCI MNL 117.

1. Place self-consolidating concrete without vibration according to PCI TR-6, "Interim Guidelines for the Use of Self-Consolidating Concrete in Precast/Prestressed Concrete Institute Member Plants."

L. Comply with PCI MNL 117 for hot- and cold-weather concrete placement.

M. Identify pickup points of architectural precast concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each architectural precast concrete unit on a surface that will not show in finished structure.

N. Cure concrete, according to requirements in PCI MNL 117, by moisture retention without heat or by accelerated heat curing using low-pressure live steam or radiant heat and moisture. Cure units until compressive strength is high enough to ensure that stripping does not have an effect on performance or appearance of final product.

O. Discard and replace architectural precast concrete units that do not comply with requirements, including structural, manufacturing tolerance, and appearance, unless repairs meet requirements in PCI MNL 117 and Architect's approval.

2.11 FABRICATION TOLERANCES

A. Fabricate architectural precast concrete units straight and true to size and shape with exposed edges and corners precise and true so each finished panel complies with PCI MNL 117 product tolerances as well as position tolerances for cast-in items.

B. Fabricate architectural precast concrete units straight and true to size and shape with exposed edges and corners precise and true so each finished panel complies with the following product tolerances:

1. Overall Height and Width of Units, Measured at the Face Exposed to View: As follows:

   a. 10 feet or under, plus or minus 1/8 inch.
   b. 10 to 20 feet, plus 1/8 inch, minus 3/16 inch.
   c. 20 to 40 feet, plus or minus 1/4 inch.
   d. Each additional 10 feet, plus or minus 1/16 inch.

2. Overall Height and Width of Units, Measured at the Face Not Exposed to View: As follows:

   a. 10 feet or under, plus or minus 1/4 inch.
   b. 10 to 20 feet, plus 1/4 inch, minus 3/8 inch.
   c. 20 to 40 feet, plus or minus 3/8 inch.
   d. Each additional 10 feet, plus or minus 1/8 inch.

3. Total Thickness or Flange Thickness: Plus 1/4 inch, minus 1/8 inch.
4. Rib Thickness: Plus or minus 1/8 inch.
5. Rib to Edge of Flange: Plus or minus 1/8 inch.
6. Distance between Ribs: Plus or minus 1/8 inch.
7. Variation from Square or Designated Skew (Difference in Length of the Two Diagonal Measurements): Plus or minus 1/8 inch per 72 inches or 1/2 inch total, whichever is greater.
8. Length and Width of Block-outs and Openings within One Unit: Plus or minus 1/4 inch.
9. Location and Dimension of Block-outs Hidden from View and Used for HVAC and Utility Penetrations: Plus or minus 3/4 inch.
10. Dimensions of Haunches: Plus or minus 1/4 inch.
11. Haunch Bearing Surface Deviation from Specified Plane: Plus or minus 1/8 inch.
12. Difference in Relative Position of Adjacent Haunch Bearing Surfaces from Specified Relative Position: Plus or minus 1/4 inch.
13. Bowing: Plus or minus L/360, maximum 1 inch.
14. Local Smoothness: 1/4 inch per 10 feet.
15. Warping: 1/16 inch per 12 inches of distance from nearest adjacent corner.
16. Tipping and Flushness of Plates: Plus or minus 1/4 inch.

17. Dimensions of Architectural Features and Rustications: Plus or minus 1/8 inch.

C. Position Tolerances: For cast-in items measured from datum line location, as indicated on Shop Drawings.

1. Weld Plates: Plus or minus 1 inch.
2. Inserts: Plus or minus 1/2 inch.
3. Handling Devices: Plus or minus 3 inches.
4. Reinforcing Steel and Welded Wire Fabric: Plus or minus 1/4 inch where position has structural implications or affects concrete cover; otherwise, plus or minus 1/2 inch.
5. Reinforcing Steel Extending out of Member: Plus or minus 1/2 inch of plan dimensions.
6. Tendons: Plus or minus 1/4 inch, vertical; plus or minus 1 inch, horizontal.
7. Location of Rustication Joints: Plus or minus 1/8 inch.
8. Location of Opening within Panel: Plus or minus 1/4 inch.
9. Location of Flashing Reglets: Plus or minus 1/4 inch.
10. Location of Flashing Reglets at Edge of Panel: Plus or minus 1/8 inch.
11. Reglets for Glazing Gaskets: Plus or minus 1/8 inch.
12. Electrical Outlets, Hose Bibs: Plus or minus 1/2 inch.
13. Location of Bearing Surface from End of Member: Plus or minus 1/4 inch.
14. Allowable Rotation of Plate, Channel Inserts, and Electrical Boxes: 2-degree rotation or 1/4 inch maximum over the full dimension of unit.
15. Position of Sleeve: Plus or minus 1/2 inch.
16. Location of Window Washer Track or Buttons: Plus or minus 1/8 inch.

2.12 FINISHES

A. Panel faces shall be free of joint marks, grain, and other obvious defects. Corners, including false joints shall be uniform, straight, and sharp. Texture and finish of exposed-face surfaces of architectural precast concrete units to match approved sample panels, as approved by the Architect.

B. Finish exposed top, bottom, and side surfaces of architectural precast concrete units to match face-surface finish.

C. Finish exposed back surfaces and unexposed surfaces to receive joint sealant of architectural precast concrete units by smooth, steel-trowel finish.

2.13 SOURCE QUALITY CONTROL

A. Quality-Control Testing: Test and inspect precast concrete according to PCI MNL 117 requirements. If using self-consolidating concrete, also test and inspect according to PCI TR-6, "Interim Guidelines for the Use of Self-Consolidating Concrete in Precast/Prestressed Concrete Institute Member Plants."

B. Owner will employ an independent testing agency to evaluate architectural precast concrete fabricator's quality-control and testing methods.

1. Allow Owner's testing agency access to material storage areas, concrete production equipment, concrete placement, and curing facilities. Cooperate with Owner's testing agency and provide samples of materials and concrete mixtures as may be requested for additional testing and evaluation.

C. Strength of precast concrete units will be considered deficient if units fail to comply with ACI 318 requirements for concrete strength.

D. Testing: If there is evidence that strength of precast concrete units may be deficient or may not comply with ACI 318 requirements, precaster will employ an independent testing agency to obtain, prepare, and test cores drilled from hardened concrete to determine compressive strength according to ASTM C 42/C 42M.

1. A minimum of three representative cores will be taken from units of suspect strength, from locations directed by Architect.
2. Cores will be tested in an air-dry condition.
3. Strength of concrete for each series of 3 cores will be considered satisfactory if average compressive strength is equal to at least 85 percent of 28-day design compressive strength and no single core is less than 75 percent of 28-day design compressive strength.
4. Test results will be made in writing on same day that tests are performed, with copies to Architect, Contractor, and precast concrete fabricator. Test reports will include the following:

a. Project identification name and number.
b. Date when tests were performed.
c. Name of precast concrete fabricator.
d. Name of concrete testing agency.
e. Identification letter, name, and type of precast concrete unit(s) represented by core tests; design compressive strength; type of break; compressive strength at breaks, corrected for length-diameter ratio; and direction of applied load to core in relation to horizontal plane of concrete as placed.

E. Patching: If core test results are satisfactory and precast concrete units comply with requirements, clean and dampen core holes and solidly fill with precast concrete mixture that has no coarse aggregate, and finish to match adjacent precast concrete surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting structural frame or foundation and conditions for compliance with requirements for installation tolerances, true and level bearing surfaces, and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. Do not install precast concrete units until supporting cast-in-place building structural framing has attained minimum allowable design compressive strength or supporting steel or other structure is complete.

3.2 INSTALLATION

A. Install clips, hangers, bearing pads, and other accessories required for connecting architectural precast concrete units to supporting members and backup materials.

B. Erect architectural precast concrete level, plumb, and square within specified allowable tolerances. Provide temporary supports and bracing as required to maintain position, stability, and alignment as units are being permanently connected.

1. Install temporary steel or plastic spacing shims or bearing pads as precast concrete units are being erected. Tack weld steel shims to each other to prevent shims from separating.
2. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
3. Remove projecting lifting devices and grout fill voids within recessed lifting devices flush with surface of adjacent precast surfaces when recess is exposed.
4. Unless otherwise indicated, maintain uniform joint widths of 3/4 inch.

C. Connect architectural precast concrete units in position by bolting, welding, grouting, or as otherwise indicated on Shop Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and grouting are completed.

1. Do not permit connections to disrupt continuity of roof flashing.

D. Welding: Comply with applicable AWS D1.1/D1.1M and AWS D1.4 for welding, welding electrodes, appearance, quality of welds, and methods used in correcting welding work.

1. Protect architectural precast concrete units and bearing pads from damage by field welding or cutting operations, and provide noncombustible shields as required.
2. Welds not specified shall be continuous fillet welds, using no less than the minimum fillet as specified by AWS.
3. Clean weld-affected metal surfaces with chipping hammer followed by brushing, and apply a minimum 4.0-mil- thick coat of galvanized repair paint to galvanized surfaces according to ASTM A 780.
4. Remove, reweld, or repair incomplete and defective welds.

E. At bolted connections, use lock washers, tack welding, or other approved means to prevent loosening of nuts after final adjustment.

1. Where slotted connections are used, verify bolt position and tightness. For sliding connections, properly secure bolt but allow bolt to move within connection slot. For friction connections, apply specified bolt torque and check 25 percent of bolts at random by calibrated torque wrench.

F. Grouting Connections: Grout connections where required or indicated. Retain grout in place until hard enough to support itself. Pack spaces with stiff grout material, tamping until voids are completely filled. Place grout to finish smooth, level, and plumb with adjacent concrete surfaces. Keep grouted joints damp for not less than 24 hours after initial set. Promptly remove grout material from exposed surfaces before it affects finishes or hardens.

3.3 ERECTION TOLERANCES

A. Erect architectural precast concrete units level, plumb, square, true, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 117, Appendix I.

B. Erect architectural precast concrete units level, plumb, square, and true, without exceeding the following noncumulative erection tolerances:

1. Plan Location from Building Grid Datum: Plus or minus 1/2 inch.
2. Plan Location from Centerline of Steel: Plus or minus 1/2 inch.
3. Top Elevation from Nominal Top Elevation: As follows:

    a. Exposed Individual Panel: Plus or minus 1/4 inch.
    b. Non-Exposed Individual Panel: Plus or minus 1/2 inch.
    c. Exposed Panel Relative to Adjacent Panel: 1/4 inch.
    d. Non-Exposed Panel Relative to Adjacent Panel: 1/2 inch.

4. Support Elevation from Nominal Support Elevation: As follows:

    a. Maximum Low: 1/2 inch.
    b. Maximum High: 1/4 inch.

5. Maximum Plumb Variation over the Lesser of Height of Structure or 100 Feet: 1 inch.
6. Plumb in Any 10 Feet of Element Height: 1/4 inch.
7. Maximum Jog in Alignment of Matching Edges: 1/4 inch.
8. Joint Width (Governs over Joint Taper): Plus or minus 1/4 inch.
9. Maximum Joint Taper: 3/8 inch.
10. Joint Taper in 10 Feet: 1/4 inch.
11. Maximum Jog in Alignment of Matching Faces: 1/4 inch.
12. Differential Bowing or Camber, as Erected, between Adjacent Members of Same Design: 1/4 inch.
13. Opening Height between Spandrels: Plus or minus 1/4 inch.

3.4 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections and prepare reports:

    1. Erection of precast concrete members.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and prepare test reports.

C. Field welds will be subject to visual inspections and nondestructive testing according to ASTM E 165 or ASTM E 709. High-strength bolted connections will be subject to inspections.

D. Testing agency will report test results promptly and in writing to Contractor and Architect.

E. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.

F. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.5 REPAIRS

A. Repair architectural precast concrete units if permitted by Architect. The Architect reserves the right to reject repaired units that do not comply with requirements.

B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 20 feet.

C. Prepare and repair damaged galvanized coatings with galvanizing repair paint according to ASTM A 780.

D. Wire brush, clean, and paint damaged prime-painted components with same type of shop primer.

E. Remove and replace damaged architectural precast concrete units when repairs do not comply with requirements.

3.6 CLEANING

A. Clean surfaces of precast concrete units exposed to view.

B. Clean mortar, plaster, fireproofing, weld slag, and other deleterious material from concrete surfaces and adjacent materials immediately.

C. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.

1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's recommendations. Clean soiled precast concrete surfaces with detergent and water, using stiff fiber brushes and sponges, and rinse with clean water. Protect other work from staining or damage due to cleaning operations.
2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Concrete masonry units.
2. Face brick.
3. Mortar and grout.
4. Masonry joint reinforcement, ties and anchors.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 04 22 00 - LOAD BEARING MASONRY.
2. Section 07 21 00 - THERMAL INSULATION for cavity wall insulation.
3. Section 07 27 00 - AIR BARRIERS for membrane air barrier and requirements for sealing at anchor attachments.
4. Section 07 62 00 – SHEET METAL FLASHING AND TRIM for through-wall flashing.
5. Section 07 84 40 - FIRE-RESISTIVE JOINT SYSTEMS for fire-resistive joint systems openings in masonry walls and at heads of masonry walls.
6. Section 07 92 00 - JOINT SEALANTS for sealing control and expansion joints in unit masonry.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. LEED Submittals:

1. Product Data for Credit MR 4: Indicating percentages by weight of postconsumer and preconsumer recycled content for products having recycled content. Include statement indicating costs for each product having recycled content.
2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material.

Include statement indicating cost for each regional material and the fraction by weight that is considered regional.

C. Shop Drawings: For the following:

1. Masonry Units: Show sizes, profiles, coursing, control joint locations, and locations of special shapes.

D. Samples for Verification: For each type and color of the following:

1. Exposed concrete masonry units.
2. Face brick, in the form of straps of five or more bricks.
3. Pigmented mortar. Make Samples using same sand and mortar ingredients to be used on Project. Label Samples to indicate types and amounts of pigments used.
4. Weep holes/vents.
5. Accessories embedded in masonry.

E. Qualification Data: For testing agency.

F. Material Certificates: Include statements of material properties indicating compliance with requirements including compliance with standards and type designations within standards. Provide for each type and size of the following:

1. Masonry units:

   a. Include material test reports substantiating compliance with requirements.
   b. For bricks, include size-variation data verifying that actual range of sizes falls within specified tolerances.
   c. For exposed brick, include material test report for efflorescence according to ASTM C 67.
   d. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.

2. Cementitious materials. Include brand, type, and name of manufacturer.
3. Mortar mixes. Include description of type and proportions of ingredients.
4. Grout mixes. Include description of type and proportions of ingredients.
5. Joint reinforcement.
6. Anchors, ties, and metal accessories.

G. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports, per ASTM C 780 for mortar mixes required to comply with property specification.
2. Include test reports, per ASTM C 1019 for grout mixes required to comply with compressive strength requirement.

H. Cold-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with cold-weather requirements.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1093 for testing indicated, as documented according to ASTM E 548.

B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, through one source from a single manufacturer for each product required.

C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from a single manufacturer for each cementitious component and from one source or producer for each aggregate.

D. Preconstruction Testing Service: The Owner will engage a qualified independent testing agency to perform preconstruction testing indicated below. Payment for these services will be made by the Owner. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.

1. Prism Test: For each type of construction required, per ASTM C 1314.

E. Fire-Resistance Ratings: Where indicated, provide materials and construction identical to those of assemblies with fire-resistance ratings determined per ASTM E 119 by a testing and inspecting agency, by equivalent concrete masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

F. Sample Panels: Build sample panels to verify selections made under sample submittals and to demonstrate aesthetic effects. Comply with requirements in Division 01 for mockups.

1. Build sample panels for typical exterior and interior walls in sizes approximately 48 inches long by 48 inches high by full thickness.
2. Where masonry is to match existing, erect panels adjacent and parallel to existing surface.
3. Clean one-half of exposed faces of panels with masonry cleaner indicated.
4. Protect approved sample panels from the elements with weather-resistant membrane.
5. Approval of sample panels is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; aesthetic qualities of workmanship; and other material and construction qualities specifically approved by Architect in writing.

a. Approval of sample panels does not constitute approval of deviations from the Contract Documents contained in sample panels unless such deviations are specifically approved by Architect in writing.

G. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01. Agenda shall include protection of air barrier membrane during construction.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers designed for lifting and emptying into dispensing silo. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in a metal dispensing silo with weatherproof cover.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.6 PROJECT CONDITIONS

A. Protection of Air Barrier Membrane: During construction, protect air barrier membrane from penetrations which allow air to pass through air barrier assemblies. Engage original installer to repair damage promptly using identical materials and methods of installation, and to the satisfaction of the Architect.

B. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.
2. Where 1 wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe and hold cover in place.

C. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least 3 days after building masonry walls or columns.

D. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

E. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and above and will remain so until masonry has dried, but not less than 7 days after completing cleaning.

F. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.1 MASONRY UNITS, GENERAL

A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to exceed tolerances and to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not uses units where such defects, including dimensions that vary from specified dimensions by more than stated tolerances, will be exposed in the completed Work or will impair the quality of completed masonry.

2.2 CONCRETE MASONRY UNITS (CMUs)

A. Regional Materials: Provide CMUs that have been manufactured within 500 miles of Project site, from aggregates and cement that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.

B. Concrete Masonry Units: ASTM C 90, normal weight unless indicated otherwise manufactured to dimensions 3/8 inch less than nominal dimensions.

C. Shapes: Provide standard shapes indicated and as required for building configuration. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.

D. Decorative Concrete Masonry Units: ASTM C 90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1900 psi
2. Weight Classification: Normal weight.
3. Size: 7-5/8 in. by 7-5/8 in. by 15-5/8 in.
4. Pattern and Texture:

    a. Standard pattern, ground finish, one face (1F), one score (1S).

5. Colors: As selected by Architect from manufacturer's full range.
6. Special Aggregate: Provide units made with aggregate matching aggregate in Architect's sample.
    a. A Jandris & Sons
    b. Trenwyth Industries.
    c. Westbrook Concrete Block Co.

2.3 BRICK

A. Regional Materials: Provide brick that has been manufactured within 500 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.

B. Face Brick: ASTM C 216, Grade SW, Type FBS.

1. Basis-of-Design: Match approved sample of SCSU Buley Library brick; Watsontown Brick Co., Atlantic Series, Landover KT (knife cut), Modular Type 8.
2. Size (Actual Dimensions): 2-1/4 in. by 3-1/2 in. by 7-5/8 in.
3. Initial Rate of Absorption: Less than 30 g/30 sq. in. per minute when tested per ASTM C 67.
4. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."
5. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Watsontown Brick Co.
   b. Glen-Gery Brick
   c. The Belden Brick Company

C. Building (Common) Brick where Concealed: ASTM C 62, Grade SW.

D. General: Provide shapes indicated and as follows:

1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
2. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.
3. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces.
4. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.
5. Units which are sawn and less than one-half full size shall not be used.

2.4 MORTAR AND GROUT MATERIALS

A. Regional Materials: Provide aggregate for mortar and grout, cement, and lime that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.

B. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

C. Hydrated Lime: ASTM C 207, Type S.

D. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes. Use only pigments with a record of satisfactory performance in masonry mortar.

1. Available Products:
   a. LanXess; Bayferrox Iron Oxide Pigments.
   b. Davis Colors; True Tone Mortar Colors.
   c. Solomon Grind-Chem Services, Inc.; SGS Mortar Colors.

E. Aggregate for Mortar: ASTM C 144. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.

F. Aggregate for Grout: ASTM C 404.

G. Water: Potable.

2.5 REINFORCEMENT

A. Masonry Joint Reinforcement, General: ASTM A 951.

1. Interior Walls: Mill-galvanized, carbon steel.
2. Exterior Walls: Hot-dip galvanized, carbon steel.
3. Wire Size and Spacing: As required by Code.
4. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.

B. Masonry Joint Reinforcement for Multiwythe Masonry:

1. Ladder type with 1 side rod at each face shell of hollow masonry units more than 4 inches in width, plus 1 side rod at each wythe of masonry 4 inches or less in width.

2.6 TIES AND ANCHORS

A. Materials: Provide ties and anchors specified in subsequent paragraphs that are made from materials that comply with subparagraphs below, unless otherwise indicated.

1. Mill-Galvanized, Carbon-Steel Wire: ASTM A 82; with ASTM A 641/A 641M, Class 1 coating.
2. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82; with ASTM A 153/A 153M, Class B-2 coating.
3. Stainless-Steel Wire: ASTM A 580/A 580M, Type 316.
4. Galvanized Steel Sheet: ASTM A 653/A 653M, Commercial Steel, G60 zinc coating.
5. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
6. Stainless Steel Bars: ASTM A 276 or ASTM A 666, Type 304.

B. Adjustable Anchors for Connecting to Structure: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch-diameter, hot-dip galvanized steel. Mill-galvanized wire may be used at interior walls, unless otherwise indicated.

C. Partition Top Anchors: Provide metal plate anchors with neoprene sponge spacer equal to PTA 422 by Hohmann & Barnard, Inc.

D. Adjustable Masonry-Veneer Anchors: POS-I-TIE

1. General: Provide anchors that allow vertical adjustment but resist tension and compression forces perpendicular to plane of wall, for attachment over sheathing to wood or metal studs, with structural performance capable of withstanding a 100-lbf load in both tension and compression without deforming or developing play in excess of 0.05 inch.
2. Screw-Attached, Masonry-Veneer Anchors: Units, equal to Pos-I-Tie Brick Veneer Anchoring System by Heckmann Building Products Inc., consisting of a wire tie and a metal anchor section.
   a. Anchor Section: Zinc-alloy barrel section with flanged head with wing-nut eye and corrosion-resistant, self-drilling screw. Eye designed to receive wire tie and to serve as head for drilling fastener into framing. Barrel length to suit sheathing thickness, allowing screw to seat directly against framing with flanged head covering hole in sheathing.
   b. Wire Ties: Triangular-, rectangular-, or T-shaped wire ties fabricated from 0.188-inch-diameter, hot-dip galvanized steel wire.

2.7 MISCELLANEOUS ANCHORS

A. Anchor Bolts: L-shaped steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153/A 153M, Class C; of dimensions indicated.

2.8 EMBEDDED FLASHING MATERIALS

A. Metal Flashings: Fabricated and furnished under Section 07 62 00 - SHEET METAL FLASHING AND TRIM.

2.9 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

D. Weep/Vent Products: Free-draining mesh; made from polyethylene strands, full height and width of head joint and depth 1/8 inch less than depth of outer wythe; in color selected from manufacturer's full color selection.

E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity. Provide strips, full-depth of cavity and 10 inches wide, with dovetail shaped notches 7 inches deep that prevent mesh from being clogged with mortar droppings or equivalent. Available products:

   1. Advanced Building Products Inc.; Mortar Break II.
   2. Archovations, Inc.; CavClear Masonry Mat.
   3. Dayton Superior Corporation, Dur-O-Wal Division; Polytite MortarStop.
   4. Mortar Net USA, Ltd.; Mortar Net.

2.10 MASONRY CLEANERS

A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

1. Available Manufacturers:

a. Diedrich Technologies, Inc.
b. EaCo Chem, Inc.
c. ProSoCo, Inc.

2.11 MORTAR AND GROUT MIXES

A. Basis-of-Design: Mortar and grout to match approved sample of SCSU Buley Library.

B. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Limit cementitious materials in mortar to portland cement and lime.

C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.

1. For masonry below grade or in contact with earth, use Type M.
2. For exterior, above-grade, non-load-bearing walls and parapet walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.

D. Pigmented Mortar: Use colored cement product. Pigments shall not exceed 10 percent of portland cement by weight.

E. Grout for Unit Masonry: Comply with ASTM C 476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
2. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
2. Verify that foundations are within tolerances specified.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.

B. Build chases and recesses to accommodate items specified in this and other Sections.

C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.

D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed. Do not use units cut to less than one-half size.

E. Do not install concrete masonry units with more than 5 percent damage to the face. Do not install brick units which will show defects after installation.

F. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.

G. Comply with construction tolerances in ACI 530.1/ASCE 6/TMS 602 and with the following:

1. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
2. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
3. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
4. For exposed bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch. Do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
5. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.
6. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.

3.3 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond pattern indicated on Drawings; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs. Prior to installation review bond pattern with Architect.

C. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

D. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

E. Fill space between steel frames and masonry solidly with mortar, unless otherwise indicated.

F. Fill cores in hollow concrete masonry units with grout 24 inches under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.

G. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above, unless otherwise indicated.

1. Install compressible filler in joint between top of partition and underside of structure above.
2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch clearance between end of anchor rod and end of tube. Space anchors 48 inches o.c., unless otherwise indicated.
3. Wedge non-load-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
4. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 07 84 40 – FIRE-RESISTIVE JOINT SYSTEMS.

3.4 MORTAR BEDDING AND JOINTING

A. Lay hollow brick and concrete masonry units as follows:

1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.

B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Set cast stone trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.

1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
2. Allow cleaned surfaces to dry before setting.

D. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness, unless otherwise indicated.

E. Cut joints flush for masonry walls to receive waterproofing, air barriers, or other direct-applied finishes (other than paint), unless otherwise indicated.

3.5 CAVITY WALLS

A. Bond wythes of cavity walls together using one of the following methods:

1. Masonry Joint Reinforcement: Installed in horizontal mortar joints. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable (two-piece) type reinforcement with continuous horizontal wire in facing wythe attached to ties to allow for differential movement regardless of whether bed joints align.
2. Masonry Veneer Anchors: Comply with requirements for anchoring masonry veneers.

B. Bond wythes of cavity walls together using bonding system indicated on Drawings.

C. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.

D. Coordinate and allow access for air and vapor barrier membrane installed in cavity under Section 07 27 00 - AIR BARRIERS.

3.6 MASONRY JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches. Space reinforcement not more than 16 inches o.c.

B. Interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

3.7 ANCHORING MASONRY TO STRUCTURAL MEMBERS

A. Anchor masonry to structural members where masonry abuts or faces structural members to comply with the following:

1. Provide an open space not less than 1 inch in width between masonry and structural member, unless otherwise indicated. Keep open space free of mortar and other rigid materials.
2. Anchor masonry to structural members with anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

3.8 ANCHORING MASONRY VENEERS

A. Refer to Section 07 27 00 - AIR BARRIERS for requirements for attaching anchors at air barriers.

B. Anchor masonry veneers with masonry-veneer anchors to comply with the following requirements:

1. Fasten screw-attached anchors through insulation and sheathing to wall framing and to concrete and masonry backup as applicable with metal fasteners of type indicated.
2. Embed tie sections in masonry joints. Provide air space indicated on the Drawings between back of masonry veneer and face of insulation.
3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
4. Space anchors as indicated on the Drawings, but not less than as required by Code.
5. Seal punctures and penetrations into air barrier membrane with manufacturer's recommended sealant.

3.9 CONTROL AND EXPANSION JOINTS

A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form control joints in concrete masonry using one of the following methods:

1. Fit bond-breaker strips into hollow contour in ends of concrete masonry units on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.
2. Install preformed control-joint gaskets designed to fit standard sash block.
3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar or rake out joint for application of sealant.
4. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.

C. Form expansion joints in brick made from clay or shale as follows:

1. Build flanges of metal expansion strips into masonry. Lap each joint 4 inches in direction of water flow. Seal joints below grade and at junctures with horizontal expansion joints if any.
2. Build flanges of factory-fabricated, expansion-joint units into masonry.
3. Build in compressible joint fillers where indicated.

4. Form open joint full depth of brick wythe and of width indicated, but not less than 3/8 inch for installation of sealant and backer rod specified in Section 07 92 00 - JOINT SEALANTS.

D. Provide horizontal, pressure-relieving joints by either leaving an air space or inserting a compressible filler of width required for installing sealant and backer rod specified in Section 07 92 00 - JOINT SEALANTS but not less than 3/8 inch.

1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

3.10 LINTELS

A. Install steel lintels where indicated.

B. Provide minimum bearing of 8 inches at each jamb, unless otherwise indicated.

3.11 FLASHING, WEEP HOLES, CAVITY DRAINAGE, AND VENTS

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Coordinate with flashings specified in Section 07 27 00 - AIR BARRIERS.

B. Fabricate flashings as specified in Section 07 62 00 – SHEET METAL FLASHING AND TRIM.

C. Install flashing as follows, unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
2. At multiwythe masonry walls, including cavity walls, extend flashing through outer wythe, turned up a minimum of 8 inches, and 1-1/2 inches into the inner wythe. Form 1/4-inch hook in edge of flashing embedded in inner wythe.
3. At masonry-veneer walls, extend flashing through veneer, across air space behind veneer, and up face of sheathing at least 8 inches; with upper edge covered with elastomeric membrane, lapping at least 4 inches.
4. At lintels and shelf angles, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, install shop fabricated inside and outside corners, fully soldered, set in two rows of sealant. Refer to Drawings for details.

D. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

E. Install weep holes in head joints in exterior wythes of first course of masonry immediately above embedded flashing and as follows:

1. Use open head joints to form weep holes.
2. Space weep holes 24 inches o.c., unless otherwise indicated.

F. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in Part 2 "Miscellaneous Masonry Accessories" Article.

G. Install vents in head joints in exterior wythes at spacing indicated.

3.12 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other temporary loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.

3.13 FIELD QUALITY CONTROL

A. Inspectors: Engage qualified independent inspectors to perform inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform inspections. Place grout only after inspectors have verified compliance of grout spaces and grades, sizes, and locations of reinforcement.

B. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections indicated below and prepare test reports. Retesting of materials failing to comply with specified requirements shall be done at Contractor's expense.

C. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof. Test types as determined by the independent testing and inspection agency.

3.14 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, around penetrations and where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
6. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.
7. Clean cast stone trim to comply with stone supplier's written instructions.

3.15 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.

1. Crush masonry waste to less than 4 inches in each dimension.
2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Section 31 20 00 - EARTH MOVING.
3. Do not dispose of masonry waste as fill within 18 inches of finished grade.

C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off the Site.

END OF SECTION 04 20 00

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Provide load bearing, concrete unit masonry, and other masonry Work as specified herein, as shown on the Drawings, and as needed for a complete and proper installation. The terms Concrete Masonry Unit (CMU) and Concrete Block are inter-changeable.

B. On-site Work and factory pre-fabricated Work of the same type shall be matching in appearance and construction.

C. For other than load bearing walls, see and coordinate with architectural masonry specification.

1.2 WORK FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Dovetail Anchor Slots

1.3 WORK INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

A. Metal Fabrications, Loose Lintels, Built-in Work - Section 05 50 00

1.4 RELATED SECTIONS

A. Cast-in-Place-Concrete - Section 03 30 00

B. Grouting – within Section 03 30 00

C. Unit Masonry – Section 04 20 00

D. Cold-Formed Steel - Section 05 40 00

1.5 DESIGN REQUIREMENTS

A. No air-entraining admixtures or material containing such shall be permitted in the mortar. Also, no anti-freeze compounds, calcium chloride, or other compounds, unless expressly permitted otherwise, shall be permitted in the mortar.

B. Mortar types to be used at the following locations, unless otherwise stated:

1. Reinforced masonry shown on structural drawings, including masonry walls supporting structural steel - Type M

2. Masonry below grade and exposed to earth - Type M

1.6 REFERENCES

A. American Society of Testing and Materials (ASTM) standards, latest editions.

1. A153 “Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Products”.

2. A240 “Standard Specification for Heat-Resisting Chromium and Chromium Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels”.

3. A580 “Standard Specification for Stainless and Heat-Resisting Steel Wire”.

4. A615 “Standard Specification for Deformed and Plain Billet - Steel Bars for Concrete Reinforcement”.

5. C33 “Standard Specification for Concrete Aggregates”.

6. C55 “Standard Specification for Concrete Building Brick.

7. C62 “Standard Specification for Building Brick (Solid Masonry Units Made from Clay or Shale)”.

8. C90 “Standard Specification for Hollow, Load-Bearing Concrete Masonry Units”.

9. C109 “Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-inch or 50 MM Cube Specimens)”.

10. C129 “Standard Specification for Non-Load-Bearing Concrete Masonry Units”.

11. C140 “Standard Methods of Sampling and Testing Concrete Masonry Units”.

12. C144 “Standard Specifications for Aggregate for Masonry Mortar”.

13. C145 “Standard Specification for Solid Load-Bearing Concrete Masonry Units”.

14. C150 “Standard Specification for Portland Cement”.

15. C207 “Standard Specification for Hydrated Lime for Masonry Purposes”.

16. C270 “Standard Specification for Mortar for Unit Masonry”.

17. C315 “Standard Specification for Clay Flue Linings”.

18. C331 “Standard Specification for normal weight; Lightweight Aggregates for Concrete Masonry Units”.

19. C404 “Standard Specifications for Aggregates for Masonry Grout”.

20. C476 “Standard Specification for Grout for Reinforced and Nonreinforced Masonry”.

21. C595 “Standard Specifications for Blended Hydraulic Cements”.

B. Industry Standards.

1. "Standard for Concrete Masonry Units" - UL 618- Underwriters Laboratory.

C. American Concrete Institute (ACI) standards

1. ACI 530-02 “Building Code Requirement for Masonry Structures”.

2. ACI 530.1-02 “Specification for Masonry Structures”.

1.7 SUBMITTALS

A. Product Data

1. Submit complete data for concrete masonry units. Submit a list indicating the maximum dry weight of each type and size of CMU to be used in the project.

2. Provide name of aggregate producer.

3. Submit control joint locations, in accordance with 04 20 00.

B. Samples

1. Submit 3 of each masonry units.

2. Submit 3 of each type of anchor, tie, continuous reinforcement.

C. Quality Control Submittals

1. Schedule of Uses: By mortar type.

2. Certificates

a. Submit the normal weight, lightweight CMU producer's certificate stating that the minimum equivalent thickness and mix design are in conformance with UL 618 for the indicated fire rating.

b. Submit normal weight, lightweight CMU producers certificate stating aggregate used is 100% lightweight, expanded shale, clay, or slate (rotary kiln) aggregate, in accordance with ASTM C331.

c. Furnish notarized Building Department affidavit from masonry manufacturer (Form 10H) stating materials delivered to project comply with the Specification requirements.

d. Furnish notarized Building Department affidavit from masonry supplier (Form 10J) stating materials delivered to project comply with the Specification requirements.

e. Submit BSA or MEA approvals.

1.8 QUALITY ASSURANCE

A. Qualifications

1. Company specializing in the Work of this Section shall have a minimum of three years experience and at least two projects with similar quantity of materials.

B. Regulatory Requirements

1. Building Code: Work of this Section shall conform to all requirements of the Connecticut State Building Code and all applicable regulations of governmental authorities having jurisdiction, including safety, health, noise, and anti-pollution regulations. Where more severe requirements than those contained in the Building Code are given in this Section, the requirements of this Section shall govern.

2. UL 618: Fire rating of CMU and assemblies shall conform to the requirements UL 618.

C. Certification

1. Reinforced and unreinforced masonry shall conform to the material acceptance, certification and inspection requirements of Chapter 21 of the International Building Code.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in undamaged condition and store in location and with protection as needed for the following:

1. All Masonry Units: Prevent harm from contaminants, temperature changes, corrosion, and other causes.

2. Concrete Masonry Units: Limit moisture absorption in conformance with the applicable ASTM.

3. Cementitious Mortar and Grout Materials: Keep in dry conditions.

4. Aggregates: Keep in dry, clean area where grading can be controlled.

5. Accessories, Ties, and Reinforcement: Keep in area to prevent corrosion and to keep clean.

1.10 ENVIRONMENTAL REQUIREMENTS

A. Construction Requirements

1. Salt or other chemicals for lowering the freezing temperature of the mortar shall not be used.

2. Masonry units, mortar, and grout shall be preconditioned and masonry protected for the following cold weather conditions:

a. Air temperature 40°F to 32°F:

1) Water and aggregates used in mortar and grout shall not be heated above 140°F.

2) Mortar sand or mixing water shall be heated to produce mortar temperatures between 40°F and 120°F at the time of mixing. When water and aggregates for grout are below 32°F, they shall be heated.

3) Glass unit masonry shall not be laid.

b. Air temperature 32°F to 25°F:

1) The mortar temperature shall be maintained above freezing until used in masonry.

2) Aggregates and mixing water for grout shall be heated to produce grout temperature between 70 °F. and 120 °F at the time of mixing. Grout temperature shall be maintained above 70 °F at the time of grout placement.

c. Air temperature 25°F to 20°F:

1) Masonry surfaces under construction shall be heated to 40 °F.

2) Wind breaks or enclosures shall be provided when the wind velocity exceeds 15 miles per hour.

3) Prior to grouting, masonry shall be heated to a minimum of 40 °F.

d. Air temperature 20°F and Below:

1) Comply with requirements of sections a. through c. above.

2) Provide enclosures and heat source to maintain a minimum air temperature of 32°F on each side of masonry construction during construction.

B. Protection Requirements

1. Minimum Daily Air Temperature of 40°F to 25°F:

a. Protect masonry from rain or snow with a weather resistant membrane for 24 hours.

2. Minimum Daily Air Temperature of 25°F to 20°F:

a. Protect masonry with complete covering of weather-resistive insulating blankets, or equal protection, for 24 hours after being completed. The time period shall be extended to 48 hours for grouted masonry, unless the only cement in the grout is Type III portland cement.

3. Minimum Daily Air Temperature below 20°F:

a. Protect masonry for at least 24 hours, maintaining air temperature above 32°F by using heated enclosures, electric heating blankets, infrared lamps, or other acceptable methods. The time period shall be extended to 48 hours for grouted masonry, unless the only cement in the grout is Type III portland cement.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Aggregate for Concrete Masonry Units (CMU)

1. Northeast Solite Corporation, Mt. Marion, N.Y.

2. Norlite Corporation, Cohoes, N.Y. or approved equal.

B. Reinforcement and Ties

1. Hohmann & Barnard, Inc., Hauppage, N.Y.

2. Dur-O-Wall, Arlington Heights, IL. or approved equal.

C. Masonry Cleaner

1. ProSoCo, Inc., South Plainfield, N.J.

2. Sure-Kleen or approved equal.

D. Mortar Additives: Biordi Co. or approved equal.

E. Calcium Silicate Masonry Units (CSMU)

1. Arriscraft U.S.A. Corporation, distributed by Tri-State Stone, Inc., New York, N.Y. or approved equal.

2.2 CMU DISTRIBUTORS

A. A Jandris & Sons
B. Trenwyth Industries
C. Westbrook Concrete Block Co.

2.3 MATERIALS

A. Base Materials

1. Portland Cement

a. Type I: ASTM C150

b. Type II: ASTM C150

2. Sand for Mortar Mix: ASTM C144
Sand shall be natural sand with 100% passing the No. 8 sieve.

3. Aggregate for CMU: 100% Light Weight aggregate: ASTM C331, expanded clay shale or slate (rotary kiln process). No mixture with other aggregates allowed.
Normal Weight: ASTM C33

4. Aggregate for Masonry Grout: ASTM C404

5. Hydrated Lime: ASTM C207; Type "S"

6. Water - Clean, potable water free of injurious materials.

7. Mortar additive for use in setting of exterior elements with horizontal surfaces exposed to weather.

   a. Additive shall be non-toxic, non-flammable, and non-hazardous during storage, mixing, application, and when cured.

   b. Finished mortar shall be resistant to urine, dilute acid, dilute alkali, sugar, brine, and calcium chlorides and other salts used in deicing salts.

8. Premixed sand and lime for mortar mixes not allowed.

B. Concrete Masonry Units (CMU)

1. Types

   a. Hollow Load Bearing: ASTM C90, Grade N-I. Aggregate shall conform to ASTM C331 (ASTM C33 for normal weight).

   b. Solid Load Bearing (units with 75% or more net area), including Bond Beam Units: ASTM C145, Grade N-I. Aggregate shall conform to ASTM C331 (ASTM C33 for normal weight).

   c. High Strength CMU: Compressive strength shall be 3500 psi. Provide only where indicated on Drawings. Aggregate shall conform to ASTM C331 (ASTM C33 for normal weight).

   d. Concrete Brick: ASTM C55, Type 1, Grade N-1, standard modular size. Aggregate shall conform to ASTM C33.

   e. Decorative Concrete Masonry Units to comply with the standard types above and match the finishes specified by the architect, including matching adjacent non bearing walls. Ground finish blocks with standard pattern to be utilized at stairs.

2. Size

   a. Nominal face dimension 8" x 16", except as noted otherwise.

   b. Provide half units, corner units, half-high units, "U" shaped lintel/bond beam units, and units of special size and shape or with multiple grinds, e.g., two faces, two ends, or any faces as required by the Drawings to accomplish the work.

3. Unit Weight: Unit weight of concrete for normal weight, lightweight aggregate CMU not to exceed 90 pcf when tested in accordance with ASTM C140 (105 pcf for the high strength CMU).

4. UL Fire Ratings: Units manufactured with equivalent solid thicknesses, face shell thicknesses, web thicknesses, and other characteristics to obtain fire ratings as indicated on the Drawings.

C. Reinforcement and Ties

1. Provide reinforcement and ties as specified herein unless otherwise noted. See non-load bearing masonry specification for ties and attachments of exterior brick and cmu walls. Provide additional reinforcement and ties as required to withstand all transportation, seismic and other design loads and to obtain fire resistance ratings.

2. Material

a. Reinforcement and Ties for Exterior Walls: Formed from stainless steel, 18-8, type 304.

1) Sheet steel: (No. 2B Finish), cold-rolled, annealed, ASTM A240.

2) Wire steel: ASTM A580.

b. Reinforcement and Ties for Interior Walls: Hot-dip galvanized (after fabrication), ASTM A153.

c. Factory-fabricated corners and tees at corners and intersecting walls for continuous type reinforcing.

D. Miscellaneous Accessories

1. Weep/Vent Products: Free-draining mesh; made from polyethylene strands, full height and width of head joint and depth 1/8" less than depth of outer wythe; in color selected from manufacturer's full color selection.

E. Reinforcing Steel

1. Deformed bars conforming to ASTM A615, Grade 60.

2.4 MIXES

A. Mortar (basic)

1. Shall conform to ASTM C270 and BIA M1-88. Provide Type I Portland cement. Masonry cement shall not be used as a substitute.

a. Type M: 1 part gray cement, 1/4 part lime, $3^3/_4$ parts dry sand. Minimum compressive strength shall be 3750 psi at 28 days.

b. Type S: 1 part gray cement, 1/2 part lime, $4^1/_2$ parts dry sand. Minimum compressive strength shall be 3000 psi at 28 days.

c. Type N: 1 part gray cement, 1 part lime, 6 parts dry sand. Minimum compressive strength shall be 750 psi at 28 days.

d. Type N "White": 1 part white cement, 1 part lime, 6 parts dry white sand. Minimum compressive strength shall be 750 psi at 28 days.

B. Colored Mortar

1. Proportion mortar coloring with other mortar mix ingredients to obtain desired color, as approved by the Authority. Provide white cement instead of gray cement where required to meet the desired color. Do not exceed 1 part pigment to 10 parts cement, by weight.

C. Grout for Masonry

1. Mixes

a. Fine Grout: 1 part Portland Cement, 0-1/10 part Hydrated Lime, $2^1/_4$-3 times the sum of volumes of cementitious materials of fine aggregate (Proportions by volumes).

b. Coarse Grout: 1 part Portland Cement, 0-1/10 part Hydrated Lime, $2^1/_4$-3 times the sum of volumes of cementitious materials of fine aggregate, and 1-2 times the sum of the volumes of cementitious materials of coarse aggregate (Portions by volume).

c. Aggregates for Mixes: ASTM C 404.

d. Grout to achieve a minimum 28 day compressive strength of 2800 psi.

2. Location

a. For spaces less than 2" in horizontal direction, use fine grout.

b. For spaces 2" and more in horizontal direction, use coarse grout.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine all adjoining Work on which this Work is in anyway dependent for proper installation and workmanship. Report to the Authority any conditions which prevent the performance of this Work.

3.2 PROTECTION

A. Cover top of masonry wall with waterproof plastic membrane at the end of the work period and at other times when Work needs to be protected from rain and other precipitation. Extend cover down sides as needed to thoroughly protect the Work.

B. During cold weather, do not use wet masonry units and frozen masonry units.

C. Do not use frozen materials or lay masonry on frozen materials; remove frozen materials from wall. Refer to Part 1 of this Section, "Environmental Requirements" for temperature restrictions.

D. Remove excess mortar from walls as soon after laying units as practicable to prevent staining and to facilitate cleaning of wall.

E. Brace walls as needed until sufficiently set, or until intersecting walls provide lateral support.

3.3 MIXING PROCEDURES FOR MORTAR

A. Measure material by volume or equivalent weight. In measuring by volume, measure ingredients by container. Do not measure by shovel.

B. Mix ingredients in a clean mechanical mixer for a minimum of 3 minutes, maximum of 5, with the minimum amount of water to produce a workable consistency.

C. Mortar that has stiffened because of evaporation of water from the mortar shall be retempered as frequently as needed to restore the required consistency. Mortar shall be used within $2^1/_2$ hours after initial mixing.

3.4 LAYING - GENERAL

A. Lay units true to dimensions, plumb and level, square; exterior and interior bond work in bond indicated on the Drawings or specified herein. Lay courses level with joints uniform; vertical joints spaced properly for plumb alignment.

B. Fill bed joints and cross joints solid with mortar. Furrowed bed and spotted cross joints not permitted. For hollow block units, apply mortar full length on all bearing surfaces.

C. "Tooth" temporary openings in exposed masonry walls, to maintain proper bond when closed.

D. Tool joints in exposed masonry units to provide a neat, smooth, compacted surface.

E. Remove excess mortar, leaving masonry surface clean.

F. Cut concrete masonry units with circular masonry saw.

G. Build-in miscellaneous metal inserts and other items not furnished under this Section but specified to be installed under this Section.

H. Use running bond, unless otherwise noted on drawings.

3.5 CONCRETE MASONRY UNITS (CMU)

A. General

1. Lay blocks in Type M mortar, with cells vertical. Provide running bond unless shown otherwise on the Drawings or as indicated below, bonded at corner angles. Provide stack bond where block will be finished wall surface exposed to view. Reinforced concrete masonry or concrete masonry walls with structural steel bearing on it shall be laid with Type M mortar.

2. Where interior partitions intersect other partition or walls, bond together with metal wall ties spaced 2'-0" o.c. min., vertically. Refer to Article on "Reinforcement".

3. Where interior walls are to be furred, secure furring with hot-dip galvanized steel ties, spaced one for each 4-square feet.

4. Extend interior partitions and furring up to underside of slabs, arches, and beams. Leave sufficient space between partition and slab/arch/ beam to install firestopping materials as specified in Section 07 27 00. If firestopping is not required, provide resilient material such as backer rod and sealant (See Section 07 90 00).

5. Leave temporary openings in interior partitions to permit passage of equipment.

6. Reinforce first two courses above all door openings with a layer of truss mesh reinforcement extending 12" beyond jambs.

7. Provide grout in cores of blocks at jambs, parapets, under lintels, and where indicated on the Drawings.

8. Bond beam units shall be filled with normal weight lightweight concrete having a minimum compressive strength of 3000 psi and reinforced as shown on details.

B. Horizontal and Vertical Face Joints

1. Make joints uniform and 3/8" thick, unless otherwise indicated.

2. Make vertical joints tight.

3. Tool joints with a smooth, non-staining tool, when thumb print hard, at surfaces to be painted or exposed.

4. Point joints tight with a trowel, in unparged masonry below grade.

5. Cut mortar joints flush in surfaces to be covered with other masonry.

6. Remove mortar protrusions that extend into cells or cavities which are to be reinforced and filled.

C. Exposed and Painted Surfaces

1. Smooth, even texture, free of chips, cracks, or other imperfections and free from any material that will stain paint.

2. Set block up with special care for plane, jointing, pattern, and cutting.

3. Keep faces of units clean; clean off mortar droppings on block face immediately.

4. Defective units will be rejected. Replace defective units with perfect units at no extra cost to the Authority.

5. Tool joints with a smooth, non-staining tool to produce a smooth and slightly concave surface.

6. See Drawings for thickness of Concrete block.

D. Control Joints

1. Construct 1/2" wide vertical control joints in partitions where indicated on the Drawings.

2. Joints to extend full height of partition (floor to underside of slab or beam).

3. Filler (where applicable)

a. Polyethylene Foam Bar, or

b. Polyurethane Type Filler

c. Width as required for partition thickness, minus 1".

d. Install filler as partition is erected.

e. Filler to extend full height of joint.

3.6 CHASES (IN PARTITIONS)

A. Provide where shown on the Drawings.

B. After the installation of mechanical work at chases has been completed and approved, fill all chases solid with masonry, mortar, concrete, or grout. Make necessary provisions for anchoring wainscots, or facings.

C. Built-in chases; do not cut-in.

3.7 CUTTING AND FITTING

A. Cut units with a motor-driven carborundum saw; provide smooth, straight edges.

B. Provide necessary cuts to fit tightly in and around mechanical installations.

C. Where split block units are used to conceal piping or other installations, provide reinforcement for bonding the split units together.

D. Drill holes neatly for attachment of handrail brackets and for other items to be attached.

3.8 REINFORCEMENT

A. Provide reinforcement and ties as specified herein. Provide additional reinforcement and ties as required to withstand all transportation, seismic and other design loads for all masonry work.

B. Interior Concrete Masonry Unit Walls: (unless otherwise noted)

1. Provide mesh continuous at every third block course.

2. Provide ties at 24" o.c. vertical spacing. Embed in masonry 4" minimum each wall.

3. Provide straps at 48" o.c. vertical spacing.

C. At structural steel locations maintain spacing of veneer anchors using anchors suited to conditions.

D. Lap ends of adjoining strips of continuous reinforcement 6".

E. Size (width) of reinforcement as required for 4", 6", 8", 10", 12” partitions.

F. In partitions where control joints are indicated, keep reinforcement 1" short of each end of blocks at control joint.

G. Install continuous rebar reinforcement over all door and mechanical openings and in first and second mortar joints above door frame or lintels.

3.9 BUILT-IN WORK

A. Where sleeves are required in brick walls or in partitions, furnish standard wrought iron pipes of necessary sizes and lengths and build in where shown.

B. Set reglets for flashing, where required, and rake out to a depth of $1^1/_2$".

C. Maintain bucks, frames, and other built-in work in their proper position. Do not remove any braces or stays from these items until they are securely supported by and fastened to masonry.

D. Set all loose lintels (exterior and interior), bolts, plates, and other items furnished under Section 05 12 00 and specified to be installed in this Section.

E. Build into partitions and walls: Frames for grilles, convectors, access doors, and boxes for electrical equipment.

F. Do not build wood blocks into walls for securing of grounds. Grounds shall be secured to the masonry by carpenter, nailing directly into masonry units or joints.

G. Where ducts pass through cross-corridor fire zone partitions, build-in frames furnished under Section 05 50 00.

H. Provide necessary special jamb blocks, regular and irregular angle blocks where required to obtain smooth, evenly jointed and regular block patterns.

3.10 MASONRY WALL REPAIRS

A. Before cleaning masonry walls, examine faces for holes, cracks, and other defects. If corrections cannot be made to provide an appearance acceptable to the Commissioner, replace defective units.

3.11 QUALITY CONTROL

A. The Professional Engineer Designated for Special/Controlled Inspection shall make inspections and any testing deemed necessary.

3.12 CLEANING

A. Concrete Masonry Units

1. Clean wall surfaces to be painted; rub with carborundum stone: remove mortar from surfaces; remove rough edges from joints.

2. Point up holes and joints. Brush with stiff bristle brush. Leave surface in condition to receive paint.

3. Clean other wall surfaces with stiff-bristle brush.

4. Do not use wire brush.

END OF SECTION

NO TEXT ON THIS PAGE

PART 1 - GENERAL

1.1 DESCRIPTION

A. General: Provide structural steel in accordance with the Contract Documents.

B. Related Work Specified Elsewhere

1. Miscellaneous framing not specifically shown on structural drawings.

2. Grouting of base plates, leveling and bearing plates.

3. Field painting except as specified herein.

4. Metal Decking.

C. Selected areas of exposed structural steel will require visual and quality review and approval by the architect. These areas include:

1. Framing and Supports at Sunshades Type S-1

2. Metal Canopy at Knuckle South Vestibule.

3. Interior Column Baseplates at Knuckle Lobby.

4. Interior Suspension Connection below Third Floor Knuckle Conference Room.

5. Interior Segmented Curtain Wall Support at Knuckle Lobby.

D. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 018110, Sustainable Design Requirements for certification level and certification requirements.

1.2 STANDARD

A. Except as modified by governing codes and by the Contract Documents, comply with the applicable provisions, and recommendations of the following:

1. AISC "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings, Load and Resistance Factor Design" (including all supplements), Third Edition 1999.

2. AISC "Code of Standard Practice for Steel Buildings and Bridges", 2000, except in Paragraph 4.4.1, delete section (a), and (c). Delete section (c) for all connections designed by the contractor's engineer. Delete section 3.2. All contract documents apply to the contractor. As regards the second paragraph of section 3.3 – comply with order of precedence in the contract documents, per section 00 72 23.

3. Industrial Fasteners Institute "Fastener Standards Book", Sections E, High-Strength Structural Bolting.

4. AISC Hollow Structural Sections Connections Manual, 1997.

5. AISC RCSC Committee 15, 2000 "Specifications for Structural Joints Using ASTM A325 or A490 Bolts".

6. AWS D1.1-2000 "Structural Welding Code".

7. AWS D1.6-1999 "Structural Welding Code - Stainless Steel"

8. SSPC "Steel Structures Painting Manual, Volume 2, Systems and Specifications".

9. Specialty Steel Industry of North America, "Design Guidelines for the Selection and Use of Stainless Steel."

B. Where the language in any of the documents referred to herein is in the form of a recommendation or suggestion, such recommendations or suggestions shall be deemed to be mandatory under this Contract.

1.3 SUBMITTALS

A. Shop Drawings: Submit shop and erection drawings for all structural steel components showing the following:

1. Types of materials, including sizes and weights of members.

2. Location, types and details of connections.

3. Openings.

4. Cleaning, surface preparation and painting schedules.

B. Samples: Submit samples of exposed structural steel at locations selected by architect to set quality standards for exposed welds.

C. Calculations: Submit calculations of all connections, unless fully detailed on the structural drawings, according to the requirements shown on the Drawings. Calculations shall bear the seal of a Professional Engineer registered in the State of Connecticut. Calculations shall be submitted and approved prior to submission of shop drawings.

D. Reports

1. Submit certified copies of mill test reports for all steel furnished. Perform mechanical and chemical tests for all material regardless of thickness or use. No part of the ASTM Specifications will be waived without written consent of the Engineer.

2. Submit copies of prequalified and other welding procedures in form prescribed in "Structural Welding Code".

3. Provide certified fastener test reports for each component lot of high-strength structural fasteners used in the project, including those for any A325 and A490 bolts, F436 washers, F959 DTI’s, A563 nuts, or F1852 twist-off bolts.

a. Certified test results of rotational capacity tests performed on galvanized structural fasteners shall be provided when such fasteners are specified or used.

E. Manufacturer's Data: Submit product data or manufacturer's specifications and installation instructions for the following products. Include laboratory test reports and other data to show compliance with specifications (including specified standards).

1. High-strength bolts (each type), including nuts and washers.
   a. Include Direct Tension Indicators.
2. Structural steel paint.
3. Shrinkage-resistant grout.

F. LEED Submittal:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating costs for each product having recycled content.
2. Product Certification for Credit MR 5: For products and materials required to comply with requirements for Regional Materials including location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.
3. For Credit IEQ 4.2: Manufacturers' product data for paints, including printed statement of VOC content.

1.4 PRODUCT HANDLING

A. Do not handle structural steel until paint has thoroughly dried. Care shall be exercised to avoid abrasions and other damage.

B. Store materials to permit easy access for inspection and identification. Keep steel members off ground by using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration. Prior to installation and tightening, fastener components shall be protected from dust, dirt, moisture and other jobsite conditions detrimental to their lubricants and finish. Fastener components that accumulate rust or dirt resulting from job-site conditions shall not be used unless they are cleaned and relubricated (Twist-off bolts shall only be relubricated by the original manufacturer).

C. Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures. Repair or replace damaged materials or structures as directed.

D. Stack material out of mud and dirt and provide for proper drainage. Protect from damage or soiling by adjacent construction operations.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Metal Surfaces, General: All steel exposed to view in the arenas are designated as Architecturally Exposed Structural Steel. For fabrication of work that will be exposed to

view, use only materials that are smooth and free of surface blemishes including pitting, rust and scale seam marks, roller marks, rolled trade names, and roughness. Remove such blemishes by grinding, or by welding and grinding, prior to cleaning, treating, and applying surface finishes.

B. Steel:

1. Structural Steel, Plates and Bars: ASTM A992, Grade 50 unless otherwise shown. Channels and Angles to be ASTM A36: 36 ksi unless otherwise shown.

2. Rectangular Hollow Structural Sections (HSS): ASTM A500 Grade B, Fy = 46 ksi Rectangular.

3. Circular HSS: ASTM A500 Grade B, Fy = 42 ksi unlesss otherwise shown.

4. Pipe: ASTM A53 Grade B Fy = 35 ksi.

5. Stainless Steel - ASTM A240 Grade 316 Fy = 30 ksi min.

C. High-Strength Structural Fasteners:

a. Heavy hex structural Bolts: Use only ASTM A325 or A490 bolts manufactured by Infasco or Vermont Fasteners.

b. Alternate design fasteners: ASTM F1852 twist-off type tension control bolts produced by either manufacturer in 2.01Ca above may be used in lieu of standard structural bolts.

c. Washers: All washers shall have an internal diameter no greater than that of a “standard hole” as defined by AISC.

d. Hardened washers: Use only through-hardened ASTM F436 washers manufactured by Infasco, Vermont Fasteners, Technical Stamping, Prestige or Wrought Washer.

e. Direct Tension Indicators: Use only ASTM F959 DTI’s manufactured by Turnasure or Bethfast.

f. Heavy hex nuts: Use only ASTM A563 heavy hex nuts manufactured by Infasco, Vermont Fasteners, or Unitite.

g. Where shown or noted as galvanized, threaded components shall be hot-dip galvanized complying with ASTM A153, with nuts lubricated in accordance with S2.1 of ASTM A563, and with rotational capacity tests performed on each assembly lot provided..

D. Direct Tension Indicators: ASTM F959, type as required.

1. Use on all A325 and A490 bolts on connections that are slip critical, including those using F1852 twist-off type bolts..

2. Prior to fabrication and erection, representatives of the engineer, the owner’s testing agency, the bolt and DTI manufacturers shall meet at the site to ensure

that bolting methods and requirements (including inspection) for tensioning of high strength structural connections are fully understood and agreed to.

E. Filler Metal

1. Electrodes for Carbon Steel: Conform to AWS "Structural Welding Code". Minimum Charpy V-notch toughness value of 20 foot-pounds at -20 degrees Fahrenheit.

F. Stud Shear Connectors: ASTM A108, Grade 1015 or 1020, cold-finished carbon steel with dimensions complying with AISC Specifications and complying with"Structural Welding Code", type and size as shown.

G. Non-metallic Shrinkage Resistant Grout: Premixed, nonmetallic, noncorrosive, nonstaining, shrinkage resistant product containing selected silica sands, Portland cement, shrinkage compensating agents, plasticizing and water-reducing agents, complying with CE-CRD-C621 and ASTM C1107, free of gas-producing or gas-releasing agents, oxidizing catalysts, inorganic accelerators and chlorides. Provide one of the following.

1. "Five Star Grout" (U.S. Grout Corp.).

2. "Masterflow 713" (Master Builders Co.).

3. "Crystex" (L&M Construction Chemicals, Inc.).

4. "Sure Grip Grout" (Dayton Superior).

H. Paint

1. For All Steel Which is Not Hidden in Final Use or Otherwise Specified: Provide the following primer compatible with the finish coats of paint; final colors to be approved by Architect. See architectural documents for finish paint. Steel that is to be painted shall be shop primed and finish coated prior to shipping to site. One

of the following:

a. "4-55 Versare" (Tnemec Co. Inc.); 2.0 - 3.5 mils d.f.t.

b. "GP-818" (Carboline Co.); 2.0 mils d.f.t.

c. "Amercoat 5105" (Ameron Protective Coatings); 2.0 - 3.0 mils d.f.t.

d. "Dulux, 67-Y-834" (E.I. DuPont de Nemours); 2.0 mils d.f.t.

e. "Ferrox 25" (Con-Lux Coatings, Inc.); 2.0 - 3.0 mils d.f.t.

2. Milled Surfaces: Light oil coating or strippable protective coating: apply as per AISC requirements prior to shipment.

3. For all steel which is in contact with subgrade, all columns starting 6 inches above finished floor down to the base plate. Provide finish coat compatible with prime coat noted above. Touch-up in field.

I. Galvanizing: All structural steel exposed to weather, including all anchor bolts, fasteners and hardware, shall be hot dipped galvanized after fabrication and touch-up galvanized in the field after erection. Except stainless steel as noted in project documents.

J. Threaded rebar fasteners/couplings: Threaded inserts and couplings for rebar splices, to develop at least 125% of the specified rebar's yield strength. F.C. Dayton Barsplice, Inc. couplings or approved equal.

K. Spine assembly 9/16" diameter stainless steel rod, grade ASTM A193 B8N, Class 2, 125 KSI tensile strength, with stainless steel cable fittings and compact adjusters with non-articulating jaw at each end.

Manufacturers to include:

a. Tripyramid Structures, Inc.

b. Ronstan

c. Jakob Rope Systems

2.2 FABRICATION

A. Shop Fabrication and Assembly: Fabricate and assemble structural assemblies in shop to greatest extent possible. Fabricate items of structural steel in accordance with AISC Specifications and as indicated on final shop drawings. Provide camber in structural members where indicated. Fabricate beams with natural camber up.

1. Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence that will expedite erection and minimize field handling of materials.

2. Special care is to be used to handle and fabricate the selected exposed structural steel elements and where finishing is required:

a. Fabricate with exposed surfaces smooth, square, and free of surface blemishes including pitting, rust, scale, and roughness.

b. Grind sheared, punched, and flame-cut edges to remove burrs and provide smooth edges and surfaces.

c. Fabricate with exposed surfaces free of mill marks, including rolled trade names and stamped or raised identification.

d. Fabricate with exposed surfaces free of seams to maximum extent possible.

e. To repair blemishes, remove blemishes by filling or grinding or by welding and grinding, before cleaning, treating, and shop priming.

f. Fabricate with piece marks fully hidden in the completed structure or made with media that permits full removal after erection.

B. Mill column and bearing stiffeners to give full bearing over the cross section. Mill contact surfaces of bearing and base plates. It is not necessary to plane bottom surfaces of plates on grout beds.

C. Drill or punch holes at right angles to the surface of the metal, not more that 1/16 in. larger than the connector diameter. Do not make or enlarge holes by burning. Drill material having a thickness in excess of the connector diameter and material thicker than 7/8 in. Holes shall be clean-cut without torn or ragged edges. Remove outside burrs resulting from drilling operations.

D. Provide holes in members to permit connection of the work of other trades. Use suitable templates for proper location of these holes. Steel requiring adjustment shall be provided with slotted holes as shown.

E. Provide holes, slots and openings required by other trades together with necessary reinforcing as shown. Use suitable templates for proper location of these opening. Where openings are shown on the Drawings or shop drawings no change in location will be permitted without prior approval.

F. Manual oxygen cutting shall be done only with a mechanically guided torch. An unguided torch may be used provide the cut is within 1/8 in. of the required line.

G. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld shear connectors in field, spaced as shown, to beams and girders in composite construction. Use automatic end welding of headed stud shear connectors in accordance with manufacturer's printed instructions.

H. Masonry Connectors: Shop attach masonry anchorage devices as indicated on the architectural documents.

2.3 CONNECTIONS

A. Connections shall be of the types shown on the Drawings unless prior approval is obtained from the Engineer. Design connections for the capacities and according to the requirements shown on the Drawings. Employ a qualified Structural Engineer licensed in the State of Connecticut to perform the structural design and detailing of connections. The general details shown on the drawings are conceptual only and unless specifically noted, do not indicate the required number of bolts or weld sizes.

B. All connections shall be one of the following:

1. High-strength structural bolts.

2. Welds.

2.4 BOLTING

A. Bolts shall be of a length that will extend not less than 1/4 in. beyond the nuts. Enter bolts into holes without damaging the thread.

B. Use fully pretensioned high-strength structural bolts in bearing and/or friction as shown. Make high-strength bolted joints without the use of erection bolts. Bring members tightly together with sufficient high-strength "fitting-up" bolts which shall be retightened as all the bolts are finally tightened. Manual torque wrenches will not be accepted for final tightening. Protect bolt heads from damage during placing. Bolted connections

that have been completely tightened and are ready for inspection shall be marked for identification.

C. Final tightening of high-strength structural bolts shall be by properly calibrated and sufficiently powerful air-impact, hydraulic or electric wrenches capable of generating ample torque for the diameter and grade of fasteners to be tensioned, unless turn-of-nut method is specifically permitted. Each wrench shall be checked for accuracy at least once daily.

2.5 WELDING

A. Do not begin structural welding until joint elements are bolted or tacked in intimate contact and adjusted to dimensions shown on Drawings, or both, with allowance for any weld shrinkage that is expected. Weld heavy sections and those having a high degree of restraint with low hydrogen type electrodes. No members are to be spliced without prior review by the Engineer.

B. Welding shall be performed by operators who have been qualified within the preceding one year period under AWS standard qualification procedure for the type of work required. All field welders shall be recertified for this project at the job site.

C. Comply with AWS prequalified tubular joint details for all HSS direct-welded connections.

D Weld sizes shown on the drawings are the required effective sizes. Increase weld leg as recommended by AWS to account for dihedral angle and root opening.

E. Visible welds at selected areas of exposed structural steel require special care and review and shall comply with the following:

1. All fillet welds are to be cleaned of all weld splatter, tack weld puddles are to be avoided. Welds to be continuous, with all such welds to be uniform in size. Weld samples for each condition to be provided prior to fabrication and erection for review and approval by Architect to establish the approved standards for use throughout the project.

2.6 SURFACE PREPARATION

A. Clean all surfaces not otherwise specified in accordance with SSPC Surface Preparation Specification No. 3 Power Tool Cleaning, or as recommended by the paint manufacturer, whichever is more stringent.

B. Cleaning shall be done after fabrication and immediately prior to shop painting or shipment. Apply shop coat of paint within 4 hours after cleaning and before rust-bloom occurs.

C. Blast cleaning operations shall not be conducted when the relative humidity of the air is greater than 85% or when the surface temperature of the steel is less than 5 deg. F.

above the temperature at which condensation will occur, or when these conditions are

anticipated. Remove all traces of blast residue and dust in a manner that will not contaminate the surfaces. Take every precaution to prevent contamination of surfaces. Workmen shall wear gloves free of grease and/or oil when handling blast cleaned steel.

2.7 SHOP PAINTING

A. All structural steel shall receive a shop coat of primer, intermediate and finish paint except as follows:

1. Contact surfaces of welded connections and areas within 2 in. of field welds.

2. Contact surfaces of high-strength bolted connections.

3. Surfaces receiving stud shear connectors.

4. Members to be galvanized.

5. Members to be concealed in final use.

B. Treat milled surfaces as specified under "Materials".

C. Apply specified primer to provide a minimum dry film thickness as recommended by the paint manufacturer except for milled surfaces. No painting shall be done when the surface temperature of the steel is below the temperature at which condensation will occur. Apply paint thoroughly and evenly to dry surfaces in accordance with manufacturer's directions. Note that multiple colors will be required for exposed steel in the arenas.

2.8 HOT-DIP GALVANIZING AND FACTORY-APPLIED ARCHITECTURAL FINISH

A. Hot-Dip Galvanizing: For steel exposed to the elements, weather or corrosive environments and other steel indicated to be galvanized, provide coating for iron and steel fabrications applied by the hot-dip process.

1. Basis-of-Design: Duragalv by Duncan Galvanizing.
2. Comply with ASTM A 123 for fabricated products and ASTM A 153 for hardware.
3. Provide thickness of galvanizing specified in referenced standards.
4. Galvanizing bath shall contain special high grade zinc and other earthly materials.
5. Fill vent holes after galvanizing, if applicable, and grind smooth.

B. Factory-Applied Architectural Finish Over Galvanized Steel: Provide factory-applied architectural coating over hot-dip galvanized steel matching approved samples.

1. Basis-of-Design: Colorgalv by Duncan Galvanizing.

2. Primer coat shall be factory-applied polyamide epoxy primer. Apply primer within 12 hours after galvanizing at the same galvanizer’s plant in a controlled environment meeting applicable environmental regulations and as recommended by the primer coating manufacturer.

3. Finish coat shall be factory-applied color-pigmented architectural finish. Apply finish coating at the galvanizer’s plant, in a controlled environment meeting applicable environmental regulations and as recommended by the finish coating manufacturer.

Finish coat shall exhibit a rugosity (smoothness) not greater than 4 rug (16-20 microns of variation) when measured by a profilometer over a 1 inch straight line on the surface of architectural and structural elements that are less than 24 pounds per running foot. Profilometer shall be capable of operating in 1 micron increments.

4. Coatings shall be certified OTC/VOC compliant and conform to applicable regulations and EPA standards.

5. Apply the galvanizing, primer, and coating within the same facility and provide single-source responsibility for galvanizing, priming and finish coating.

6. Clean galvanized surface to create an acceptable profile for coatings. Galvanizer shall certify that performance will be met without blast cleaning and coating will be applied within 12 hours of galvanizing at the galvanizer's plant. If blasted, galvanizer shall certify that rugosity standards are met.

7. Primer shall meet or exceed the following performance criteria:

a. Abrasion Resistance per ASTM D 4060 (CS17 Wheel, 1,000 grams load),1kg Load: 200 mg loss.

b. Adhesion per ASTM D4541: 1050 psi.

c. Corrosion Weathering per ASTM D5894, 13 Cycles, 4,368 Hours: Rating 10 per ASTM D714 for blistering; Rating 7 per ASTM D610 for rusting.

d. Direct Impact Resistance per ASTM D2794: 160 in. lbs.

e. Flexibility per ASTM D522, 180º Bend, 1 in. Mandrel: Passes.

f. Pencil Hardness per ASTM D3363: 3B.

g. Moisture Condensation Resistance per ASTM D4585, 100º F, 2000 Hours: Passes, no cracking or delamination.

h. Dry Heat Resistance per ASTM D2485: 250º F.

8. Topcoat shall meet or exceed the following performance criteria:

a. Abrasion Resistance per ASTM D 4060, CS17 Wheel, 1,000 Cycles 1kg Load: 87.1 mg loss.

b. Adhesion per ASTM D 4541: 1050 psi.

c. Direct Impact Resistance per ASTM D2794: >28 in. pounds.

d. Indirect Impact Resistance per ASTM D2794: 12-14 in. pounds.

e. Dry Heat Resistance per ASTM D2485: 200° F.

f. Salt Fog Resistance per ASTM B 117 9,000 Hours: Rating 10 per ASTM D714 for blistering.

g. Flexibility per ASTM D522, 180° Bend, 1/8 in. Mandrel: Passes.

h. Pencil Hardness per ASTM D3363: 2H.

i. Moisture Condensation Resistance per ASTM D4585, 100° F, 1000 Hours: No blistering or delamination Xenon Arc Test per ASTM D 4798: Pass 300 hours

2.9 SOURCE QUALITY CONTROL

A. Testing and inspection of structural steel will be performed by a testing agency retained by the Owner. Provide the testing agency with the following:

1. A complete set of accepted documents required under Paragraph "Submittals".

2. Cutting lists, order sheets, material bills, and shipping bills.

3. Information as to time and place of all rollings and shipment of material to shops.

4. Representative sample pieces as requested by the testing agency.

5. Full and ample means and assistance for testing all materials.

6. Proper facilities, including scaffolding, temporary work platforms, etc., for inspection of the work in the mills, shop and field.

B. Each person installing connections shall be assigned an identifying symbol or mark and all shop and field connections shall be so identified so that inspector can refer back to the person making the connection.

C. The Inspector will perform his duties, when possible, in such a way that fabrication and erection are not unnecessarily delayed or impeded, and as follows:

1. The inspector will make all tests and inspections as required by all applicable federal, state and local Building Laws. The inspector shall make all the tests and inspections indicated on the Drawings.

2. The technique for radiographic inspection will be in accordance with Section 6, Part B of the "Structural Welding Code". A double film technique will be used. One copy of each film will be sent to the Engineer, the other will be retained by the Inspector.

3. Ultrasonic inspection will be performed in accordance with Section 6, Part C of the "Structural Welding Code".

4. Shop welds will be inspected in the shop before the work is painted or approved for shipment.

5. The inspector will make all tests and inspections of high strength structural bolt connections as required by AISC "Specifications for Structural Joints Using ASTM A325 or A490 Bolts".

a. Undertensioned A325 and A490 bolts are to be further tightened until they meet acceptable inspection criteria for tension. Use of ,stick-wax' lubricant can facilitate ease of tightening.

b. Undertensioned F1852 twist-off bolts, evidenced by shearing of the 'break-neck' prior to minimum required clamp force, shall be removed and replaced with new twist-off bolts. (Under no circumstances is lubrication of twist-off bolts permitted other than by the original manufacturer.

6. Where inspection reveals defects, the extent of inspection will be increased as much as necessary to assure that the full extent of the defects in a joint have been found and to assure that the same defects are not present on similar parts or under similar circumstances.

7. Work that is not acceptable will be designated by "Repair" or "Reject", as applicable.

8. The Inspector will maintain a daily record of the work he has inspected and its disposition. One copy of each of the reports will be submitted to the Engineer on a weekly basis.

a. Welding reports of test will be made in form prescribed in the "Structural Welding Code".

PART 3 - EXECUTION

3.1 PRE-CONSTRUCTION MEETING

A. Prior to the start of the Work, meet at the Project site to review methods and sequence of structural steel erection, quality control requirements, standard of workmanship, job organization, coordination of the work with other trades, special details and conditions, testing and inspection procedures, and other pertinent topics related to the Work. The meeting shall include Owner's Representative, the Architect, the Engineer, the Contractor, the Structural Steel Subcontractor, the Owner's Testing Laboratory, and any other subcontractors whose work requires coordination with this Work. Also see requirements of Part 2.01.D.2 with regards to bolting.

3.2 CONDITION OF SURFACE

A. Examine the substrates, adjoining construction and the conditions under which the Work is to be installed. Do not proceed with the Work until unsuitable conditions have been corrected. Consider all conditions which will affect the satisfactory erection of the structural steel systems.

B. Visit the project site and advise Engineer of any discrepancy or conflict. Field verify existing construction requirements, existing conditions, restrictions and clearances which may affect structural steel systems erection. Assume responsibility for all errors of detailing and fabrication and for the correct fitting and erection of the structural steel systems.

3.3 ERECTION

A. Erection sequencing drawings shall be submitted for review. The contractor shall hire GMS to analyze the proposed lifting points and erection procedures for the arena roof trusses.

B. Check the alignment and elevations of all column supports and location of all anchor bolts with transit and level instruments before starting erection. Notify Engineer of any errors. Obtain Engineer's approval of methods proposed for correcting errors prior to proceeding with corrections and erection.

C. Drift Pins may be used only to align the several parts. They shall not be used in such manner as to distort or damage the metal.

D. Oxygen cutting of structural steel for "fitting-up" purposes shall not be done except with the acceptance of the Engineer.

E. Make all necessary provisions for temporary shoring and bracing with connections of sufficient strength to bear imposed loads and for completion of erection where structural members are temporarily left out for erection at a later date. Provide temporary planking and working platforms as necessary to effectively complete the work.

F. Setting Bases and Bearing Plates: Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean bottom surface of base and bearing plates.

1. Set loose and attached base plates and bearing plates for structural members on wedges or other adjusting devices.

2. Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims, but if protruding, cut off flush with edge of base or bearing plate prior to packing with grout.

3. Pack grout solidly between bearing surfaces and bases or plates to ensure that no voids remain. Finish exposed surfaces, protect installed materials, and allow to cure.

4. For proprietary grout materials, comply with manufacturer's instructions.

G. Field Assembly: Set structural frames accurately to lines and elevations indicated. Align and adjust various members forming part of complete frame or structure before permanently fastening. Clean bearing surfaces and other surfaces that will be in permanent contact before assembly. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

H. Interaction with non-structural elements: The steel structure requires interaction with non-structural elements for strength and stability. Such elements include all steel floor deck and concrete slabs, all roof deck, cast in place concrete at the arena seating. Provide temporary bracing as required for the steel structure until the entire building structure is complete.

I. Loads during erection: Provide temporary bracing as required for all loads imposed on the steel structure during construction, including but not limited to that resulting from the attachment of precast concrete wall panels.

J. Lateral load resisting system: The lateral load resisting system includes all foundation elements, all braced and moment frames shown on the drawings, all columns and the framing connecting them, all floor deck and concrete metal deck slabs, all roof deck.

3.4 CONNECTIONS

A. Connections shall comply with requirements specified in Part 2 - Products. Bolts, nuts and washers shall be clean of dirt and rust and lubricated immediately prior to installation (except twist-off bolts, which if used, may not be lubricated by anyone other than the original manufacturer).

B. Stud shear connectors shall be attached in accordance with requirements of "Structural Welding Code".

3.5 FIELD PAINTING

A. Field painting shall comply with the requirements specified in Part 2 - Products, "Shop Painting".

B. After erection, clean exposed surfaces of field connections, unpainted areas adjacent to field connections and damaged areas in the shop coat to the same standards as required for the shop coat and paint with the same primer and finish paint used in the shop coat.

3.6 ERECTION TOLERANCE

A. Individual pieces shall be plumbed, leveled and aligned in accordance with the requirements of the "Code of Standard Practice for Steel Buildings and Bridges" except as follows.

1. Plumbness of individual columns shall be held to 1:1000.

2. The centerline of any two (2) adjacent exterior columns shall be within 3/4 inch of each other.

3. All intermediate exterior columns shall be within 1/2 inch of a line between the corner columns.

4. All measurements relating to the above shall be on the theoretical centerline of the columns.

B. Dimensions shown on Drawings are based on an assumed design temperature of 70 deg. F. Fabrication and erection procedures shall take into account the ambient temperature range at the time of the respective operations.

3.7 SURVEY

A. Make an accurate survey of actual column locations and elevations immediately upon the completion of every second level of steel and immediately submit same to the engineer. Resurvey shall include level below. Should column locations vary beyond the allowable tolerances, take necessary corrective measures prior to proceeding to next level and modify details and/or procedure as required.

B. Survey all beam elevations at each end and at center span as applicable as required to establish the in-place camber both prior to and following pouring the supported concrete slab areas. Immediately submit same to engineer.

3.8 FIELD QUALITY CONTROL

A. Field testing and inspection requirements shall comply with Part 2 - Products, "Source Quality Control".

END OF SECTION 05 12 00

PART 1 - GENERAL

1.1 DESCRIPTION

A. General: Provide metal decking in accordance with the Contract Documents.

B. Related Work Specified Elsewhere

1. Structural steel.

2. Cast-in-place concrete.

1.2 STANDARDS

A. Except as modified by governing codes and by the Contract Documents, comply with the applicable provisions and recommendations of the following:

1. AISI "Specifications for the Design of Light Gauge Cold-Formed Steel Structural Members".

2. AWS D1.1 "Structural Welding Code".

3. SDI "Design Manual for Composite Decks, Form Decks and Roof Decks".

4. AISC "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings".

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 018110, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

1.3 SUBMITTALS

A. Shop Drawings: Submit shop drawings and manufacturer's data for the following items:

1. Layout of deck panels, including location, gauge and size of each shop piece of decking, details of special conditions, closure panels, sump pans, cut openings, accessories and supplementary framing where required. Provide full layout and description of embedments and indentations of metal decking, including sizes and spacings. Show welding details to structural framing and side lap connection details.

2. Shear connector layouts for each beam, including sizes, spacings and coordination with metal deck ribs. Include data indicating adjustments to shear capacities due to deck configuration or grouping.

B. Reports and Certifications

1. Submit copies of prequalification and other welding procedures in a form and manner prescribed in AWS "Standard Qualification Procedure".

2. Submit certified test reports and certifications showing that composite deck sections will develop a minimum factor of safety of 2 for total load on single span condition.

3. Submit manufacturer's certifications stating that galvanizing complies with the specified requirements.

C. Calculations: Submit calculations for all deck design criteria and span conditions. Calculations shall bear the seal of a Professional Engineer registered in the state of Connecticut.

D. Product Data: Submit, for Architect's information only, copies of manufacturer's specifications and installation instructions for metal deck, shear connectors, paint and accessories specified.

E. Statement of Acceptability: Provide a statement of acceptability from the manufacturer of products which are to be installed on the concrete fill and require venting of the metal deck for application of their products, stating that the vent openings are adequate and are not in conflict with their guarantee requirements.

F. LEED Submittal:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.

a. Include statement indicating costs for each product having recycled content.

2. Product Certification for Credit MR 5: For products and materials required to comply with requirements for Regional Materials including location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.

3. For Credit IEQ 4.2: Manufacturers’ product data for paints, including printed statement of VOC content.

1.4 STORAGE AND HANDLING

A. Storage: Store materials off the ground, protected from damage and in manner to permit easy access for inspection and identification. Provide for proper drainage. Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures. Store packaged materials in unopened containers.

B. Handling: Handle materials in a manner so as to protect surfaces and to prevent distortion of, or damage to, fabricated deck.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Steel Decking, Galvanized: ASTM A653, Grade A, Fy = 40,000 psi minimum, galvanized in accordance with ASTM A525, Coating Designation G60 for all steel decking. Provide tabs or clips for hanging loads.

B. Miscellaneous Steel Shapes: ASTM A36, shop prime painted, unless otherwise shown or specified.

C. Shear Connectors: Through-deck stud welded shear connectors, type and size as shown. Provide connectors from one of the following manufacturers:

1. KSM Fastening Systems Division (Omark Industries).

2. Nelson Stud Welding Division (TRW, Inc.).

3. Blue Arc Welding Studs (Erico Products, Inc.).

D. Accessories: ASTM A526, commercial quality, galvanized. Provide accessories of every kind required to complete the installation of metal decking in the system shown, and as required to provide a finish surface for the application of insulation and roofing,. Finish sheet metal items to match finish of decking. Include the following:

1. Cover plates to close gaps, changes in deck direction, around columns, access openings, and around openings due to the construction sequence.

2. Supplemental support framing where normal deck bearing is precluded by columns, flange plates, gusset plates, or other framing geometry and around minor openings, around openings due to the construction sequence and wherever required to support fireproofing.

3. Sheet metal closures, pour stops, cant strips, ridge and valley plates, and continuous edging at open ends of slabs and openings and edges in floors and roof.

At bridge roof, the metal deck at the intersection of curves is to be continuously supported with 1/4" thick A36 plates rolled to shape.

E. Paint

1. Touch-Up For Galvanized Deck: Zinc rich paint for repairing galvanized surfaces and field welds. Prepare surfaces and repair in accordance with ASTM A780.

2.2 FABRICATION

A. General: Fabricate deck units in lengths to span three or more supports, unless otherwise shown; with flush, telescoped or nested 2 in. laps at ends and interlocking or nested side laps; of metal thickness, depth and width as shown.

B. Composite and Non-Composite Floor Decks: Comply with the depth and gage requirements, physical cross-sectional properties of the deck and design criteria shown on the Drawings and as follows:

1. Design the decking for non-shored condition for the wet weight of concrete. Concrete thickness used in the calculations shall include allowance for deck deflections and steel framing deflections. See Cast-In-Place Concrete Specification for additional information on additional concrete. Include allowance for construction loads. Design the decking for a limiting deflection of 0.75 in. or a maximum stress of 0.6 Fy based on either a single span loading or the loading of a single span of multiple span conditions.

2. Design the decking as a composite deck for the superimposed dead and live loads as indicated, on a simple span condition with a limiting deflection of L/360, steel stress of 0.75 Fy and f'c complying with ACI 318 (working stress).

3. Where metal decking with concrete occurs below roofing or waterproofing membranes, provide metal decking with perforations at the bottom to permit venting of moisture from concrete.

4. Comply with other design criteria as indicated in metal decking notes.

5. Provide deck gauges as required by calculation, but not less than 20 ga. Where decking cannot be designed for the non-shored condition, for instance at certain single span conditions, shore the deck during concrete placement and cure.

6. All metal floor and roof deck assemblies shall have a diaphragm shear value of no less than 400 pounds per linear foot without the 1/3 stress increase.

C. Miscellaneous Items

1. Metal cover Plates: Fabricate metal cover plates for end-abutting floor deck units of not less than same thickness and finish as decking. Form to match contour of deck units and approximately 6 in. wide.

2.3 QUALITY CONTROL

A. The Owner will engage, at his own expense, a Testing Agency satisfactory to the Architect to inspect metal decking and shear connector installation, to perform tests specified, and to submit reports to the Architect.

1. The Testing Agency will be responsible for conducting and interpreting the tests, will clearly state in each report the area tested, whether or not the test result comply with the Contract Documents, will specifically note any deviations therefrom, and will indicate corrective measures required and taken.

2. Provide the Testing Agency with the following.

   a. A complete set of accepted shop and erection drawings.

   b. Cutting lists, order sheets, material bills, shipping bills and test reports.

   c. Information as to time and place of rollings and shipment of materials to the shop.

   d. Representative sample pieces requested for testing.

   e. Full and ample means and assistance for testing.

   f. Proper facilities, including scaffolding, temporary work platforms and hoisting facilities for inspection of the Work in the mills, shop and field.

3. Each person installing connections shall be assigned an identifying symbol or mark and all shop and field connections shall be so identified so that the Inspector can refer back to the person making the connection.

4. The Inspector will perform his duties, when possible, in such a way that fabrication and erection are not unnecessarily delayed or impeded, and as follows:

   a. Where inspection reveals defects, the extent of inspection will be increased as much as necessary to assure that the full extent of the defects in a joint have been found and to assure that the same defects are not present on similar parts or under similar circumstances.

   b.. Work that is not acceptable will be designated by "Repair" or "Reject", as applicable.

   c. The Inspector will maintain a daily record of the work he has inspected and its disposition. One copy of each of the reports will be submitted

      to the Architect on a weekly basis. Welding reports of tests will be made in a form prescribed in the "Structural Welding Code".

5. The Contractor shall provide and pay for corrective measures, including additional testing and inspection.

PART 3 EXECUTION

3.1 PRE-INSTALLATION MEETING

A. Prior to the start of the Work, and at the Contractor's direction, meet at the Project site to review material selections, methods and sequence of metal

decking installation, special details and conditions, standard of workmanship, quality control requirements, job organization, coordination with other trades, and other pertinent topics related to the Work. The meeting shall include the Architect, the Contractor, the Contractor's project superintendent, metal decking subcontractor's superintendent, Owner's Testing Agency, primary component materials suppliers, and any other subcontractors whose work requires coordination with this Work.

3.2 CONDITION OF SURFACES

A. Examine the substrates, adjoining construction and conditions under which the Work is to be installed. Do not proceed with the Work until unsatisfactory conditions have been corrected.

B. Verify that the metal decking is free from oil or other substances which would impair adhesion of either concrete or spray-on fireproofing. Clean decking as required to comply with requirements of spray-on fireproofing and/or concrete.

3.3 GENERAL

A. Install deck units and accessories in accordance with manufacturer's recommendations and instructions and final shop drawings.

B. Do not place deck units on concrete supporting structure until concrete has cured and is dry.

C. Coordinate with structural steel erector for delivery and location of decking bundles to prevent overloading of structural members. Do not use floor deck units for storage or working platforms until units are permanently secured.

3.4 ERECTION

A. Place deck units on supporting steel framework and adjust to final position with ends accurately aligned and bearing on supporting members before being permanently fastened. Do not stretch or contract side lap interlocks. Align deck units for entire length of run of cells and with close alignment between cells at ends of abutting units. Place deck units flat, square and secured to adjacent framing without warp or deflection.

B. Attach panels to each structural support with 3/4 in. fusion welds spaced not more than 12 in. on center. At joints, weld both panels to support.

1. Button-punch or weld side joints 2 ft. 6 in. on center.

2. Lap end joints in roof panels 2 in.

3. Secure accessories by tack welding, with at least one weld at every corner.

4. Touch-up welds and field cuts with touch-up paint as specified promptly after installation.

5. Provide metal joint covers at abutting ends and changes in direction of floor deck units.

C. Provide tabs or clips for hanging loads where indicated. Do not hang concentrated loads exceeding 50 lbs. from the metal decking.

D. Shear connectors as indicated are based on the allowable shear capacities for shear connectors in concrete slabs as listed in the "Load and Resistance Factor Design Specifications for Structural Steel Buildings". Actual shear connector capacities must be determined by tests on the type of decking supplied and the number of connectors required in each rib. If additional shear connectors are required due to decreases in the allowance shear values, provide such shear connectors.

E. Apply shear connectors in accordance with the manufacturer's printed instructions. Use only personnel and equipment authorized by the manufacturer.

F. Use through-deck shear connector welding where gage thickness permits proper shear connector welding to develop the strength required. Provide adequate test results to verify the feasibility of through-deck shear connector welding for the particular shear connector size and gage thickness involved.

G. If through-deck shear connector welding is not feasible, install shear connectors in prepunched holes in the decking. Provide prepunched holes only for the shear connectors involved and keep hole oversize to a minimum.

H. At columns, perimeters, shafts, stairs, other openings and areas requiring field cutting, cut decking tight and provide measures and methods to assure deck can support loads. Provide tight fitting closures at open uncovered ends and edges of decking, and miscellaneous supports required to carry metal decking. Secure hole reinforcement to decking with fillet across flutes and projecting beyond sides of openings equal to maximum size of opening unless otherwise shown. Provide angles channels and other attachments required for opening through decking for ducts, shafts, piping and other penetrations. Perform field cutting and trimming square and neat and equal to factory cutting.

I. Secure closures and angle into position by welding at 18 in. centers maximum unless otherwise shown. Provide angle closures at openings, concrete retainer flashings and transition flashing as required to make decking complete and ready to receive concrete fill.

J. Where deck is required to be supported directly by concrete or masonry materials, fasten deck to the support with fasteners spaced not more than 12 in. on center. Fasteners shall be HILTI Kwik-Con II+ Fastening System, or equal, ¼" diameter with 1 ¾" embedment. Follow fastener manufacturer's installation instructions.

3.5 FIELD QUALITY CONTROL

A. Establish the welding procedure for the plug weld of the metal decking for each gage used as follows. This procedure is to be witnessed by the Owner's Testing Agency.

1. Start by clamping a piece of the decking on the top flange of a scrap beam or plate of at least ½ in. thickness with the edge of the decking protruding over the edge of the beam by 3 in.

2. Use welding cables of length and size similar to that which will be used on the actual construction.

3. Make a good 3/4 in. puddle weld through the decking to the beam with the crater filled and reasonable reinforcement above the decking. The following are suggested settings for this equipment.

   a. Electrode: E-60.

   b. Three (3) welds per electrode.

   c. 19 second duration per weld.

   d. Burn-off rate of 4.7 seconds per in.

4. When the weld has cooled, strike the edge of the decking with a sledge hammer so as to rotate the decking around the puddle weld until the decking or the weld breaks.

5. Measure the diameter of the weld nugget remaining on the structural steel. If the weld is not satisfactory, adjust the amperage and repeat by making test welds and breaking them until the proper 3/4 in. nugget is obtained. Once the proper welds are consistently obtained, a minimum of three (3) welds, make another test weld by first welding on a scrap plate to consume at least 6 in. of a new electrode and then immediately, while the electrode is still hot , making another puddle weld. Test this weld and compare the results with the welds made previously and considered satisfactory.

6. Using the same electrode, power supply unit, setting, and cable lengths established above, determine an average burn-off rate for three (3) electrodes. Then make another puddle weld as a final check on the procedure.

7. Qualify each welder on the metal decking using the above procedure, prior to welding any metal decking to the structure.

3.6 CLEAN-UP AND TOUCH-UP PAINTING

A. Clean-up: Remove metal cuttings and construction debris. Remove grease, oil and other foreign material from metal decking which would prevent proper bonding of concrete fill, sprayed-on fireproofing of roofing materials. Remove ceramic ferrules from all shear studs.

B. Touch-up Painting: After installation, wire brush, clean and paint scarred and abraded areas, welds and rust spots on top and bottom surfaces of decking units and supporting steel members.

1. Touch-up galvanized surfaces with specified galvanizing repair paint applied in accordance with ASTM A780 and manufacturer's written instructions.

END OF SECTION 05 30 00

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Exterior non-load-bearing wall framing including mechanical attic.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 05 50 00 - METAL FABRICATIONS for masonry shelf angles and connections.
2. Section 06 16 00 - SHEATHING for exterior sheathing applied to cold-formed metal framing.
3. Section 09 21 10 - GYPSUM BOARD ASSEMBLIES for interior non-load-bearing, metal-stud framing and ceiling-suspension assemblies.
4. Section 09 21 20 - GYPSUM BOARD SHAFT-WALL ASSEMBLIES for interior non-load-bearing, metal-stud-framed, shaft-wall assemblies.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design framing, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Provide cold-formed metal framing capable of withstanding design loads within limits and under conditions indicated.

1. Design Loads: As required by code.

2. Deflection Limits: Design framing systems to withstand design loads within deflections greater than the following:

a. Exterior Non-Load-Bearing Framing:
   1) Horizontal deflection of l/240 of the wall height for metal panel systems.
   2) Horizontal deflection of 1/600 of the wall height for masonry systems.

3. Design framing systems to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.
4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load, plus superimposed dead load, deflection of primary building structure.

C. Cold-Formed Steel Framing, General: Design according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions."

1. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

1.4 SUBMITTALS

A. Product Data: For each type of cold-formed metal framing product and accessory indicated.

B. LEED Submittals:

1. Product Data for Credit MR 4: Indicating percentages by weight of postconsumer and preconsumer recycled content for products having recycled content. Include statement indicating costs for each product having recycled content.
2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.
3. For Credit IEQ 4.2: Manufacturers' product data for paints, including printed statement of VOC content.

C. Shop Drawings: Show layout, spacings, sizes, thicknesses, and types of cold-formed metal framing; fabrication; and fastening and anchorage details, including mechanical fasteners. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

1. For cold-formed metal framing indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer licensed in the jurisdiction where Project is located responsible for their preparation.

D. Welding certificates.

E. Qualification Data: For professional engineer.

F. Product Test Reports: From a qualified testing agency, unless otherwise stated, indicating that each of the following complies with requirements, based on evaluation of comprehensive tests for current products:

1. Steel sheet.
2. Expansion anchors.
3. Power-actuated anchors.
4. Mechanical fasteners.

5. Vertical deflection clips.
6. Miscellaneous structural clips and accessories.

1.5 QUALITY ASSURANCE

A. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a qualified professional engineer.

B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of cold-formed metal framing that are similar to those indicated for this Project in material, design, and extent.

C. Product Tests: Mill certificates or data from a qualified independent testing agency, or in-house testing with calibrated test equipment indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, ductility, and metallic-coating thickness.

D. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."

E. AISI Specifications and Standards: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel Framing - General Provisions."

1. Comply with AISI's "Standard for Cold-Formed Steel Framing - Truss Design."
2. Comply with AISI's "Standard for Cold-Formed Steel Framing - Header Design."

F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering cold-formed metal framing that may be incorporated into the Work include, but are not limited to, the following:

1. Clark Steel Framing.
2. Consolidated Fabricators Corp.; Building Products Division.
3. Dietrich Metal Framing; a Worthington Industries Company.

4. MarinoWare; a division of Ware Industries.
5. Super Stud Building Products Inc.

2.2 MATERIALS

A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.

B. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:

1. Grade: As required by structural performance.
2. Coating: G90.

C. Steel Sheet for Vertical Deflection Clips: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:

1. Grade: As required by structural performance.
2. Coating: G90 (Z275).

2.3 EXTERIOR NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0538 inch (16 gauge).

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: Matching steel studs.
2. Flange Width: 1-1/4 inches.

C. Vertical Deflection Clips: Manufacturer's standard clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Dietrich Metal Framing; a Worthington Industries Company.
b. MarinoWare, a division of Ware Industries.
c. The Steel Network, Inc.

2.4 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated.

2.5 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.

B. Anchor Bolts: ASTM F 1554, threaded carbon-steel bolts, and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153/A 153M, Class C.

C. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

1. Acceptable Manufacturers: Kwik-Bolt 3 by Hilti, Inc., TruBolt Wedge Anchor by ITW Red Head or Power-Stud by Powers Fasteners.

D. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.

E. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.

1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

F. Welding Electrodes: Comply with AWS standards.

2.6 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035 or ASTM A 780.

1. Provide interior, field-applied paint with a VOC content of 250 g/L or less, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107, with fluid consistency and 30-minute working time.

C. Shims: Load bearing, high-density multimonomer plastic, nonleaching.

D. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.

B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that are required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

C. Install sealer gaskets to isolate the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

A. Cold-formed metal framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed metal framing according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions" and to manufacturer's written instructions unless more stringent requirements are indicated.

C. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened.

1. Cut framing members by sawing or shearing; do not torch cut.
2. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.

D. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

E. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

F. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.

G. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.

H. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.4 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.

B. Fasten both flanges of studs to top and bottom track, unless otherwise indicated. Space studs as follows:

1. Stud Spacing: 16 inches.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.

E. Install horizontal bridging in wall studs, spaced in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.

F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, fasteners, and stud girts, to provide a complete and stable wall-framing system.

3.5 FIELD QUALITY CONTROL

A. Testing: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Remove and replace work where test results indicate that it does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.6 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 40 00

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. All Work in this Section, including Schedule in Paragraph 2.1 of this Section.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 03 30 00 - CAST-IN-PLACE CONCRETE for lintels, sleeves, anchors, inserts, plates and similar items.
2. Section 04 20 00 - UNIT MASONRY for lintels, miscellaneous metal and iron sleeves, anchors, inserts and plates to be built into masonry walls.
3. Section 05 12 00 - STRUCTURAL STEEL FRAMING for structural steel items.
4. Section 05 51 00 - METAL STAIRS AND RAILINGS for steel stairs, handrails, and guardrails.
5. Section 05 53 00 - METAL GRATINGS for metal bar gratings.
6. Section 05 75 00 - DECORATIVE FORMED METAL for ornamental fabrications.
7. Section 09 90 00 - PAINTING AND COATING for field painting work of this section.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance of Ladders: Provide ladders capable of withstanding the effects of loads and stresses within limits and under conditions specified in ANSI A14.3.

B. Thermal Movements: Provide exterior metal fabrications that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Nonslip aggregates and nonslip-aggregate surface finishes.
2. Metal nosings and treads.
3. Paint products.
4. Grout.

B. LEED Submittals:

1. Product Data for Credit MR 4: Indicating percentages by weight of postconsumer and preconsumer recycled content for products having recycled content. Include statement indicating costs for each product having recycled content.
2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.
3. For Credit IEQ 4.2: Manufacturers' product data for paints, including printed statement of VOC content.

C. Shop Drawings: Show fabrication and installation details for metal fabrications.

1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
2. Provide templates for anchors and bolts specified for installation under other Sections.
3. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer licensed in the jurisdiction where Project is located, responsible for their preparation.
4. Where fabrications are to receive sprayed-on fireproofing, include statement that primer is compatible with fireproofing proposed for use.

D. Welding certificates.

E. Qualification Data: For professional engineer.

F. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 QUALITY ASSURANCE

A. Delegated Design: Design ladders and miscellaneous framing and supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of metal fabrications that are similar to those indicated for this Project in material, design, and extent.

C. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code--Steel."
2. AWS D1.3, "Structural Welding Code--Sheet Steel."
3. AWS D1.6, "Structural Welding Code--Stainless Steel."

D. Metal Surfaces, General: Provide materials with smooth, flat surfaces, unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.
2. Provide allowance for trimming and fitting at site.

1.7 COORDINATION

A. Coordinate installation of anchorages for metal fabrications. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

B. Coordinate installation of steel weld plates and angles for casting into concrete that are specified in this Section but required for work of another Section. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 SCHEDULE

A. Miscellaneous and ornamental items include the following. Requirements for materials, hot-dip galvanizing, and shop-applied primers are included with each item as applicable.

1. Loose steel bearing and leveling plates, including bearing plates for steel joists, galvanized at exterior locations and in exterior walls.
2. Galvanized steel lintels with shop-applied primer at exterior locations.
3. Steel lintels with shop-applied zinc-rich primer at interior locations.
4. Galvanized shelf angles with shop applied primer at exterior locations.
5. Shelf angles with zinc-rich shop-applied primer at interior locations.
6. Steel elevator machine beams.
7. Steel support angles for elevator door sills.
8. Cants in elevator hoistways made from sheet steel.
9. Miscellaneous steel framing and supports:
   a. Galvanized steel framing and supports for overhead doors.

b. Galvanized steel framing and supports for mechanical and electrical equipment.
c. Steel framing and supports for utility line trays.
d. Steel framing and supports for applications where framing and supports are not specified in other Sections; galvanized at exterior locations and in exterior walls.
e. Prefinished slotted steel channel support framing.
f. Steel framing and supports with shop-applied primer for countertops.
g. Steel framing and supports for toilet partitions.

10. Ladders:
    a. Steel ladders at interior locations, shop-primed.
    b. Steel elevator pit ladders.
11. Miscellaneous steel trim including steel angle corner guards, steel edgings, and loading-dock edge angles, galvanized at exterior locations and in exterior walls.
12. Galvanized steel bollards with shop-applied primer.
13. Galvanized pipe guards with shop-applied primer.
14. Steel floor plate and frame.
15. Cast gray iron nosings.
16. Exterior stainless steel trellis.

2.2 FERROUS METALS

A. Recycled Content of Steel Products: Provide products with average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.

B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

C. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 316L at exterior.

D. Stainless-Steel Bars and Shapes: ASTM A 276, Type 316L at exterior.

E. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.

F. Steel Tubing: ASTM A 500, cold-formed steel tubing.

G. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.

    1. Provide Schedule 80 pipe for bollards.

H. Slotted Channel Framing: Cold-formed metal channels with continuous slot complying with MFMA-4.

I. Cast Iron: ASTM A 48/A 48M, Class 30, unless another class is indicated or required by structural loads.

2.3 FASTENERS

A. General: Unless otherwise indicated, provide Type 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, at exterior walls. Provide stainless-steel fasteners for fastening aluminum. Select fasteners for type, grade, and class required.

B. Anchor Bolts: ASTM F 1554, Grade 36. Provide hot-dip or mechanically deposited, zinc-coated anchor bolts where item being fastened is indicated to be galvanized.

C. Cast-in-Place Anchors in Concrete: Anchors capable of sustaining, without failure, a load equal to four times the load imposed, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

1. Threaded or wedge type; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, hot-dip galvanized per ASTM A 153/A 153M.

D. Expansion Anchors: Anchor bolt and sleeve assembly with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

1. Acceptable Manufacturers: Kwik-Bolt 3 by Hilti, Inc., TruBolt Wedge Anchor by ITW Red Head or Power-Stud by Powers Fasteners.

E. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches by length indicated with anchor straps or studs not less than 3 inches long at not more than 8 inches o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B 633, Class Fe/Zn 5, as needed for fastening to inserts.

2.4 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

C. Zinc-Rich Primer: Complying with SSPC-Paint 20 or SSPC-Paint 29 and compatible with topcoat.

1. Provide interior, field-applied primer with a VOC content of 250 g/L or less, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

1. Provide interior, field-applied paint with a VOC content of 250 g/L or less, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

F. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.5 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch, unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work true to line and level with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts, unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

2.6 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

2.7 LOOSE STEEL LINTELS

A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Weld adjoining members together to form a single unit where indicated.

B. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span but not less than 8 inches, unless otherwise indicated.

2.8 SHELF ANGLES

A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inchbolts, spaced not more than 6 inches from ends and 24 inches o.c., unless otherwise indicated.

1. Provide mitered and welded units at corners.
2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches larger than expansion or control joint.

B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.

C. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.

2.9 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction, unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.

1. Fabricate units from slotted channel framing where indicated.
2. Furnish inserts if units are installed after concrete is placed.

2.10 METAL LADDERS

A. General:

1. Comply with ANSI A14.3, unless otherwise indicated.
2. For elevator pit ladders, comply with ASME A17.1.
3. Support each ladder at top and bottom and not more than 60 inches o.c. with welded or bolted brackets, made from same metal as ladder.
4. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.

2.11 METAL BOLLARDS

A. Fabricate metal bollards from Schedule 80 steel pipe.

B. Fabricate bollards with 3/8-inch-thick steel baseplates for bolting to concrete slab. Drill baseplates at all 4 corners for 3/4-inch anchor bolts.

1. Where bollards are to be anchored to sloping concrete slabs, angle baseplates for plumb alignment of bollards.

2.12 PIPE GUARDS

A. Fabricate pipe guards from 3/8-inch-thick by 12-inch--wide steel plate, bent to fit flat against the wall or column at both ends and to fit around pipe with 2-inch clearance between pipe and pipe guard. Drill each end for two 3/4-inch anchor bolts.

2.13 METAL FLOOR PLATE

A. Fabricate from rolled-steel floor plate of minimum 1/4 inch steel unless thicker units are required for anticipated loadings.

B. Include steel angle stiffeners, and fixed and removable sections as indicated.

C. Provide flush steel bar drop handles for lifting removable sections, one at each end of each section.

2.14 ABRASIVE METAL NOSINGS

A. Cast-Metal Units: Cast gray iron, Class 20 with an integral abrasive finish consisting of aluminum oxide, silicon carbide, or a combination of both. Fabricate units in sizes and configurations indicated and in lengths necessary to accurately fit openings or conditions.

B. Drill for mechanical anchors and countersink. Locate not more than 4 inches from ends and not more than 12 inches o.c., evenly spaced between ends, unless otherwise indicated. Provide closer spacing if recommended by manufacturer.

C. Apply bituminous paint to concealed bottoms, sides, and edges of cast-metal units set into concrete.

2.15 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish metal fabrications after assembly.

2.16 STEEL PRIMERS AND FINISHES

A. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed metal fabrications:

1. Exteriors (SSPC Zone 1B) and Items Indicated to Receive Zinc-Rich Urethane Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Interiors (SSPC Zone 1A): SSPC-SP 7, "Brush Off Blast Cleaning."
3. Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes and those to be field welded, embedded in concrete or masonry, unless otherwise indicated. Extend priming of partially embedded members to a depth of 2 inches.
4. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
5. Comply with SSPC-PA 2, "Measurement of Dry Coating Thickness with magnetic Gages."

B. Zinc-Rich Primer: Urethane zinc rich primer compatible with topcoat Specified in Section 09 90 00 - PAINTS AND COATINGS. Provide primer with a VOC content of 340 g/L (2.8 lb/gal.) or less per OTC and HAPS COMPLIANT STANDARDS PER 2007 standards when calculated according to 40 CFR 59, Subpart D (EPA Method 24). Provide Tnemec Series 394 Perimerprime at 3.0 mils DFT or approved equal by DuPont or Carboline.

1. Provide interior, field-applied primer with a VOC content of 250 g/L or less, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.17 HOT-DIP GALVANIZING

A. Hot-Dip Galvanizing: For steel exposed to the elements, weather or corrosive environments and other steel indicated to be galvanized, provide coating for iron and steel fabrications applied by the hot-dip process.

1. Basis-of-Design: Duragalv by Duncan Galvanizing.
2. Comply with ASTM A 123 for fabricated products and ASTM A 153 for hardware.
3. Provide thickness of galvanizing specified in referenced standards.
4. Galvanizing bath shall contain special high grade zinc and other earthly materials.
5. Fill vent holes after galvanizing, if applicable, and grind smooth.

2.18 HOT-DIP GALVANIZING AND FACTORY-APPLIED ARCHITECTURAL FINISH

A. Hot-Dip Galvanizing: For steel exposed to the elements, weather or corrosive environments and other steel indicated to be galvanized, provide coating for iron and steel fabrications applied by the hot-dip process.

1. Basis-of-Design: Duragalv by Duncan Galvanizing.
2. Comply with ASTM A 123 for fabricated products and ASTM A 153 for hardware.
3. Provide thickness of galvanizing specified in referenced standards.
4. Galvanizing bath shall contain special high grade zinc and other earthly materials.
5. Fill vent holes after galvanizing, if applicable, and grind smooth.

B. Architectural Finish: For steel exposed to the elements, weather or corrosive environments and other steel indicated to be galvanized, provide coating for iron and steel fabrications applied by the hot-dip process.

1. Basis-of-Design: Colorgalv by Duncan Galvanizing.
2. Primer coat shall be factory-applied polyamide epoxy primer. Apply primer within 12 hours after galvanizing at the same galvanizer's plant in a controlled environment meeting applicable environmental regulations and as recommended by the primer coating manufacturer.
3. Finish coat shall be factory-applied color-pigmented architectural finish. Apply finish coating at the galvanizer's plant, in a controlled environment meeting applicable environmental regulations and as recommended by the finish coating manufacturer. Finish coat shall exhibit a rugosity (smoothness) not greater than 4 rug (16-20 microns of variation) when measured by a profilometer over a 1 inch straight line on the surface of architectural and structural elements that are less than 24 pounds per running foot. Profilometer shall be capable of operating in 1 micron increments.
4. Coatings shall be certified OTC/VOC compliant and conform to applicable regulations and EPA standards.
5. Apply the galvanizing, primer, and coating within the same facility and provide single-source responsibility for galvanizing, priming and finish coating.

6. Clean galvanized surface to create an acceptable profile for coatings. Galvanizer shall certify that performance will be met without blast cleaning and coating will be applied within 12 hours of galvanizing at the galvanizer's plant. If blasted, galvanizer shall certify that rugosity standards are met.
7. Primer shall meet or exceed the following performance criteria:
   a. Abrasion Resistance per ASTM D 4060 (CS17 Wheel, 1,000 grams load),1kg Load: 200 mg loss.
   b. Adhesion per ASTM D4541: 1050 psi.
   c. Corrosion Weathering per ASTM D5894, 13 Cycles, 4,368 Hours: Rating 10 per ASTM D714 for blistering; Rating 7 per ASTM D610 for rusting.
   d. Direct Impact Resistance per ASTM D2794: 160 in. lbs.
   e. Flexibility per ASTM D522, 180º Bend, 1 in. Mandrel: Passes.
   f. Pencil Hardness per ASTM D3363: 3B.
   g. Moisture Condensation Resistance per ASTM D4585, 100ºF, 2000 Hours: Passes, no cracking or delamination.
   h. Dry Heat Resistance per ASTM D2485: 250ºF.
8. Topcoat shall meet or exceed the following performance criteria:
   a. Abrasion Resistance per ASTM D 4060, CS17 Wheel, 1,000 Cycles 1kg Load: 87.1 mg loss.
   b. Adhesion per ASTM D 4541: 1050 psi.
   c. Direct Impact Resistance per ASTM D2794: >28 in. pounds.
   d. Indirect Impact Resistance per ASTM D2794: 12-14 in. pounds.
   e. Dry Heat Resistance per ASTM D2485: 200°F.
   f. Salt Fog Resistance per ASTM B 117 9,000 Hours: Rating 10 per ASTM D714 for blistering.
   g. Flexibility per ASTM D522, 180° Bend, 1/8 in. Mandrel: Passes.
   h. Pencil Hardness per ASTM D3363: 2H.
   i. Moisture Condensation Resistance per ASTM D4585, 100°F, 1000 Hours: No blistering or delamination Xenon Arc Test per ASTM D 4798: Pass 300 hours.

C. Color: Custom color to match Architect's sample.

2.19 STAINLESS-STEEL FINISHES

A. Remove tool and die marks and stretch lines or blend into finish.

B. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.

C. Bright, Directional Satin Finish: No. 4.

D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges

and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag bolts, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.

3.2 INSTALLING BEARING AND LEVELING PLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.

B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.

1. Use nonshrink grout, either metallic or nonmetallic, in concealed locations where not exposed to moisture; use nonshrink, nonmetallic grout in exposed locations, unless otherwise indicated.
2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.3 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

B. Anchor supports for operable partitions securely to and rigidly brace from building structure.

C. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.

1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in this Section.

D. Install pipe columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified in this Section.

1. Grout baseplates of columns supporting steel girders after girders are installed and leveled.

3.4 INSTALLING PIPE BOLLARDS

A. Anchor bollards in place with concrete footings. Center and align bollards in holes 3 inches above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.

B. Fill bollards solidly with concrete, mounding top surface to shed water.

3.5 INSTALLING PIPE GUARDS

A. Provide pipe guards at exposed vertical pipes in parking garage where not protected by curbs or other barriers. Install by bolting to wall or column with expansion anchors. Provide four 3/4-inch bolts at each pipe guard. Mount pipe guards with top edge 26 inches above driving surface.

3.6 INSTALLING NOSINGS, TREADS, AND THRESHOLDS

A. Center nosings on tread widths.

B. For nosings embedded in concrete steps or curbs, align nosings flush with riser faces and level with tread surfaces.

C. Seal thresholds exposed to exterior with elastomeric sealant complying with Section 07 92 00 - JOINT SEALANTS to provide a watertight installation.

3.7 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

B. Touch-Up and Repair for Galvanized Surfaces: For damaged and field-welded metal coated surfaces, clean welds, bolted connections and abraded areas.

1. For galvanized surfaces, apply organic zinc repair paint complying with requirements of ASTM A 780, modified to 95 percent zinc in dry film. Galvanizing repair paint shall have 95 percent zinc by weight, ZiRP by Duncan Galvanizing. Thickness of applied

galvanizing repair paint shall be not less than coating thickness required by ASTM A 123 or A 153 as applicable. Touch-up of galvanized surfaces with silver paint, brite paint, or aluminum paints is not acceptable..

2. For factory-applied finish coatings, field-touch-up shall be performed by factory approved personnel for warranties to apply. Touch-up shall be such that repair is not visible from a distance of 6 feet. If non factory-approved technicians are used for field touch-up, no warranties shall exist.
3. A touch-up repair kit or touchup instructions shall be provided to the Owner for each type of factory-applied finish.

END OF SECTION 05 50 00

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Preassembled steel stairs with concrete filled treads.
2. Preassembled steel stairs with stone treads at Knuckle Lobby, Monumental stair and Stair 2 Ground level.
3. Interior industrial-type stairs and catwalks with steel grating treads at Lover Level Mechanical Room.
4. Steel tube railings, interior and exterior.
5. Steel tube handrails, interior and exterior.
6. Steel tube guardrails, interior and exterior.
7. Exterior galvanized steel post, rails, balustrade railing system at metal panel parapet wall.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 051200 - STRUCTURAL STEEL FRAMING for attachment of steel rail system.
2. Section 05 50 00 - METAL FABRICATIONS for metal treads and nosings not installed in metal stairs.
3. Section 05 53 00 - METAL GRATING for grating.
4. Section 05 73 00 - DECORATIVE METAL RAILINGS for steel and glass, stainless steel and glass railings.
5. Section 06 10 00 - ROUGH CARPENTRY for wood blocking for anchoring railings.
6. Section 074200 - METAL WALL PANELS for attachment to steel rail system.
7. Section 09 21 10 - GYPSUM BOARD ASSEMBLIES for metal backing for anchoring railings.
8. Section 096340 - STONE FLOORING for stone stair treads.
9. Section 09 90 00 - PAINTING AND COATING for field painting work of this section.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design stairs and railings, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance of Stairs: Provide metal stairs capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Uniform Load and Concentrated Loads: As required by Code.
2. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
3. Limit deflection of treads, platforms, and framing members to L/360 or 1/4 inch, whichever is less.

C. Structural Performance of Railings: Provide railings capable of withstanding the effects of gravity loads and Code required loads and stresses within limits and under conditions indicated.

D. Seismic Performance: Provide metal stairs capable of withstanding the effects of earthquake motions determined according to Code.

1.4 SUBMITTALS

A. Product Data: For metal stairs and the following:

1. Site-filled metal-pan stair treads.
2. Paint products.
3. Grout.

B. LEED Submittals:

1. Product Data for Credit MR 4: Indicating percentages by weight of postconsumer and preconsumer recycled content for products having recycled content. Include statement indicating costs for each product having recycled content.
2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.
3. For Credit IEQ 4.2: Manufacturers' product data for paints, including printed statement of VOC content.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Provide templates for anchors and bolts specified for installation under other Sections.
2. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer, licensed in the jurisdiction where Project is located, responsible for their preparation.

D. Welding certificates.

E. Qualification Data: For professional engineer.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," for class of stair designated, unless more stringent requirements are indicated.

1. Preassembled Stairs: Commercial class.
2. Industrial-Type Stairs and Catwalks: Industrial class.
3. Ornamental Stairs: Architectural class.

C. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code--Steel."
2. AWS D1.3, "Structural Welding Code--Sheet Steel."

1.6 COORDINATION

A. Coordinate installation of anchorages for metal stairs. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

B. Coordinate locations of hanger rods and struts with other work so that they will not encroach on required stair width and will be within the fire-resistance-rated stair enclosure.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces, unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.2 FERROUS METALS

A. Recycled Content of Steel Products: Provide products with average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.

B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

C. Steel Tubing: ASTM A 500 (cold formed) or ASTM A 513, Type 5 (mandrel drawn).

D. Steel Bars for Grating Treads: ASTM A 36/A 36M or steel strip, ASTM A 1011/A 1011M or ASTM A 1018/A 1018M.

E. Wire Rod for Grating Crossbars: ASTM A 510.

F. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.

G. Uncoated, Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M either commercial steel, Type B, or structural steel, Grade 30, unless another grade is required by design loads.

H. Galvanized Steel Sheet: ASTM A 653/A 653M, G90 coating, either commercial steel, Type B, or structural steel, Grade 33, unless another grade is required by design loads.

2.3 FASTENERS

A. General: Provide zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 25 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required.

2.4 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Shop Primers: Provide primers that comply with Section 09 90 00 - PAINTING AND COATING.

C. Zinc-Rich Primer: Complying with SSPC-Paint 20 or SSPC-Paint 29 and compatible with topcoat.

D. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

1. Use primer with a VOC content of 420 g/L (3.5 lb/gal.) or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Provide interior, field-applied paint with a VOC content of 250 g/L or less, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

F. Concrete Materials and Properties: Comply with requirements in Section 03 30 00 - CAST-IN-PLACE CONCRETE for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3000 psi, unless otherwise indicated.

2.5 FABRICATION, GENERAL

A. Provide complete stair assemblies, including metal framing, hangers, struts, railings, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.

1. Join components by welding, unless otherwise indicated.
2. Use connections that maintain structural value of joined pieces.
3. Fabricate treads and platforms of exterior stairs so finished walking surfaces slope to drain.

B. Preassembled Stairs: Assemble stairs in shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch, unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

E. Form exposed work true to line and level with accurate angles and surfaces and straight edges.

F. Weld connections to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Weld exposed corners and seams continuously, unless otherwise indicated.
5. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated. Locate joints where least conspicuous.

H. Comply with “Guideline 1: Joint Finishes”, by National Ornamental & Miscellaneous Metals Association (NOMMA), as follows:

1. Typical Railing: Type 2 or better, unless otherwise indicated.
2. Service Stair Railing: Type 3 or better, unless otherwise indicated.
3. Ornamental Railing: Type 1.

I. Fabricate joints that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

2.6 STEEL-FRAMED STAIRS

A. Available Manufacturers:

1. Alfab, Inc.
2. American Stair, Inc.
3. Worthington Metal Fabricators, formerly Sharon Companies Ltd. (The).

B. Stair Framing:

1. Fabricate stringers of steel plates or channels. Provide closures for exposed ends of stringers.
2. Construct platforms of steel plate or channel headers and miscellaneous framing members as needed to comply with performance requirements.
3. Weld stringers to headers; weld framing members to stringers and headers.
4. Where stairs are enclosed by gypsum board or shaft-wall assemblies, provide hanger rods or struts to support landings from floor construction above or below. Locate hanger rods and struts where they will not encroach on required stair width and will be within the fire-resistance-rated stair enclosure.
5. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.

C. Metal-Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness needed to comply with performance requirements but not less than 0.0677 inch.

1. Steel Sheet: Uncoated hot-rolled steel sheet, unless otherwise indicated.
2. Directly weld metal pans to stringers; locate welds on top of subtreads where they will be concealed by concrete fill. Do not weld risers to stringers.
3. Shape metal pans to include nosing integral with riser.
4. Provide subplatforms of configuration indicated or, if not indicated, the same as subtreads. Weld subplatforms to platform framing.

D. Metal Bar-Grating Stairs and Catwalks: Form treads and platforms to configurations shown from metal bar grating; fabricate to comply with NAAMM MBG 531, "Metal Bar Grating Manual."

1. Fabricate treads and platforms from welded steel grating with openings in gratings no more than 5/16 inch in least dimension.
2. Surface: Plain.
3. Finish: Shop primed at interior, galvanized at exterior locations.
4. Fabricate grating treads with cast abrasive nosing and with steel angle or steel plate carrier at each end for stringer connections. Secure treads to stringers with bolts.
5. Fabricate grating platforms with nosing matching that on grating treads. Provide toeplates at open-sided edges of grating platforms. Weld grating to platform framing.

2.7 STEEL TUBE RAILINGS

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of tube, post spacings, and anchorage, but not less than that needed to withstand indicated loads.

B. Welded Connections: Fabricate railings with welded connections. Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

C. Form changes in direction of railings as detailed on the Drawings.

D. Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

E. Close exposed ends of railing members with prefabricated end fittings.

F. Provide wall returns at ends of wall-mounted handrails, unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.

G. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and for attaching to other work. Furnish inserts and other anchorage devices for connecting to concrete or masonry work.

1. Connect posts to stair framing by direct welding, unless otherwise indicated.
2. For galvanized railings, provide galvanized fittings, brackets, fasteners, sleeves, and other ferrous-metal components.

3. For nongalvanized railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors embedded in exterior masonry and concrete construction.

H. Infill Panels: Provide infill panels at decorative steel railing with laser cut patterns as indicated on the Drawings.

I. Fillers: Provide fillers made from steel plate, or other suitably crush-resistant material, where needed to transfer wall bracket loads through wall finishes to structural supports. Size fillers to suit wall finish thicknesses and to produce adequate bearing area to prevent bracket rotation and overstressing of substrate.

2.8 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish metal stairs after assembly.

2.9 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with applicable standard listed below:

1. ASTM A 123/A 123M, for galvanizing steel and iron products.
2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.
3. Fill vent and drain holes that will be exposed in finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
4. Handrails: Galvanizing shall exhibit a rugosity (smoothness) not greater than 4 rug (16-20 microns of variation) when measured by a profilometer over a 1 inch straight line on the surface of the railings.

B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed products:

1. Exterior Stairs (SSPC Zone 1B): SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Interior Stairs (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."

C. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.

C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete, unless otherwise indicated.

D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

E. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

F. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

G. Place and finish concrete fill for treads and platforms to comply with Section 03 30 00 - CAST-IN-PLACE CONCRETE.

1. Install abrasive nosings with anchors fully embedded in concrete. Center nosings on tread width.

3.2 INSTALLING STEEL TUBE RAILINGS

A. Adjust railing systems before anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated or, if not indicated, as required by design loads. Plumb posts in each direction. Secure posts and rail ends to building construction as follows:

1. Anchor posts to steel by welding directly to steel supporting members.
2. Anchor handrail ends to concrete and masonry with steel round flanges welded to rail ends and anchored with postinstalled anchors and bolts.

B. Attach handrails to wall with wall brackets. Provide bracket with 1-1/2-inch clearance from inside face of handrail and finished wall surface. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads. Secure wall brackets to building construction as follows:

1. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt.
2. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
3. For hollow masonry anchorage, use toggle bolts.

4. For steel-framed gypsum board assemblies, fasten brackets directly to steel framing or concealed steel reinforcements using self-tapping screws of size and type required to support structural loads.

3.3 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 05 51 00

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Metal bar gratings at areaways.
2. Metal frames and supports for gratings.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 03 30 00 - CAST-IN-PLACE CONCRETE for anchors, inserts, plates and similar items.
2. Section 05 12 00 - STRUCTURAL STEEL FRAMING for structural-steel framing system components.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design gratings, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Gratings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.

1. Floors: Uniform load of 250 lbf/sq. ft. or concentrated load of 3000 lbf, whichever produces the greater stress.
2. Sidewalks and Vehicular Driveways, Subject to Trucking: Uniform load of 250 lbf/sq. ft. or concentrated load of 8000 lbf, whichever produces the greater stress.
3. Limit deflection to L/360 or 1/4 inch, whichever is less.

C. Seismic Performance: Provide gratings capable of withstanding the effects of earthquake motions determined according to ASCE/SEI 7.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Formed-metal plank gratings.
2. Extruded-aluminum plank gratings.
3. Glass-fiber-reinforced plastic gratings.
4. Clips and anchorage devices for gratings.
5. Paint products.

B. LEED Submittals:

C. LEED Submittals:

1. Product Data for Credit MR 4: Indicating percentages by weight of postconsumer and preconsumer recycled content for products having recycled content. Include statement indicating costs for each product having recycled content.
2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.
3. For Credit IEQ 4.2: Manufacturers' product data for paints, including printed statement of VOC content.

D. Shop Drawings: Include plans, sections, details, and attachments to other work.

E. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

F. Qualification Data: For qualified professional engineer.

G. Mill Certificates: Signed by manufacturers of stainless-steel sheet certifying that products furnished comply with requirements.

H. Welding certificates.

I. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.5 QUALITY ASSURANCE

A. Metal Bar Grating Standards: Comply with NAAMM MBG 531, "Metal Bar Grating Manual" and NAAMM MBG 532, "Heavy-Duty Metal Bar Grating Manual."

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3, "Structural Welding Code - Sheet Steel."

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with gratings by field measurements before fabrication.

1.7 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for gratings, grating frames, and supports. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 FERROUS METALS

A. Recycled Content of Steel Products: Provide products with average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.

B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

C. Steel Bars for Bar Gratings: ASTM A 36/A 36M or steel strip, ASTM A 1011/A 1011M or ASTM A 1018/A 1018M.

D. Wire Rod for Bar Grating Crossbars: ASTM A 510.

E. Uncoated Steel Sheet: ASTM A 1011/A 1011M, structural steel, Grade 30.

F. Galvanized-Steel Sheet: ASTM A 653/A 653M, structural quality, Grade 33, with G90 coating.

G. Expanded-Metal Carbon Steel: ASTM F 1267, Class 1.

H. Expanded-Metal Galvanized Steel: ASTM F 1267, Class 2, Grade A.

2.2 FASTENERS

A. General: Unless otherwise indicated, provide Type 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

1. Provide stainless-steel fasteners for fastening aluminum.
2. Provide stainless steel fasteners for fastening stainless steel.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.

C. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.

1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

D. Plain Washers: Round, ASME B18.22.1.

E. Lock Washers: Helical, spring type, ASME B18.21.1.

F. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.

2.3 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy that is welded.

B. Shop Primers: Provide primers that comply with Section 09 90 00 - PAINTING AND COATING.

C. Zinc-Rich Primer: Complying with SSPC-Paint 20 or SSPC-Paint 29 and compatible with topcoat.

1. Use primer with a VOC content of 420 g/L (3.5 lb/gal.) or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Provide interior, field-applied primer with a VOC content of 250 g/L or less, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

1. Provide interior, field-applied paint with a VOC content of 250 g/L or less, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.4 FABRICATION

A. Shop Assembly: Fabricate grating sections in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch material cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form from materials of size, thickness, and shapes indicated, but not less than that needed to support indicated loads.

D. Fit exposed connections accurately together to form hairline joints.

E. Welding: Comply with AWS recommendations and the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.

F. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space the anchoring devices to secure gratings, frames, and supports rigidly in place and to support indicated loads.

1. Fabricate toeplates to fit grating units and weld to units in shop unless otherwise indicated.
2. Fabricate toeplates for attaching in the field.
3. Toeplate Height: 4 inches unless otherwise indicated.

2.5 METAL BAR GRATINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Alabama Metal Industries Corporation; a Gibraltar Industries company.
2. Fisher & Ludlow; Division of Harris Steel Limited.
3. IKG Industries; a division of Harsco Corporation.
4. Ohio Gratings, Inc.

B. Removable Grating Sections: Fabricate with banding bars attached by welding to entire perimeter of each section. Include anchors and fasteners of type indicated or, if not indicated, as recommended by manufacturer for attaching to supports.

C. Fabricate cutouts in grating sections for penetrations indicated. Arrange cutouts to permit grating removal without disturbing items penetrating gratings.

1. Edge-band openings in grating that interrupt four or more bearing bars with bars of same size and material as bearing bars.

D. Do not notch bearing bars at supports to maintain elevation.

2.6 GRATING FRAMES AND SUPPORTS

A. Frames and Supports for Metal Gratings: Fabricate from metal shapes, plates, and bars of welded construction to sizes, shapes, and profiles indicated and as necessary to receive gratings. Miter and weld connections for perimeter angle frames. Cut, drill, and tap units to receive hardware and similar items.

1. Unless otherwise indicated, fabricate from same basic metal as gratings.

2. Equip units indicated to be cast into concrete or built into masonry with integrally welded anchors. Unless otherwise indicated, space anchors 24 inches o.c. and provide minimum anchor units in the form of steel straps 1-1/4 inches wide by 1/4 inch thick by 8 inches long.

2.7 STEEL FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish gratings, frames, and supports after assembly.

C. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing gratings to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing gratings. Set units accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete or masonry.

D. Fit exposed connections accurately together to form hairline joints.

1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade the surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

E. Attach toeplates to gratings by welding at locations indicated.

F. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.

G. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

3.2 INSTALLING METAL BAR GRATINGS

A. General: Install gratings to comply with recommendations of referenced metal bar grating standards that apply to grating types and bar sizes indicated, including installation clearances and standard anchoring details.

B. Attach removable units to supporting members with type and size of clips and fasteners indicated or, if not indicated, as recommended by grating manufacturer for type of installation conditions shown.

C. Attach nonremovable units to supporting members by welding where both materials are same; otherwise, fasten by bolting as indicated above.

3.3 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 requirements for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 09 painting Sections.

C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 05 53 00

SECTION 05 55 00

ALUMINUM FABRICATIONS

PART 2 - GENERAL

2.6 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

2.7 SUMMARY

A. This Section includes the following:

1. Aluminum framing for outdoor water feature.

2. All connection and connector material required to install and support this system.

3. Coordination with other trade contractors that have components of their work installed on, within or contiguous with the Aluminum Fabrications.

B. Products furnished, but not installed, under this Section include the following:
1. Anchor bolts and wedge-type inserts indicated to be installed into concrete.

C. Related Sections include the following:

1. Division 3 Section "Cast-in-Place Concrete" for installing anchor bolts, wedge-type inserts and other items indicated to be cast into concrete.
2. Division 5 Section "Structural Steel."
3. Division 5 Section "Metal Fabrications."

2.8 PERFORMANCE REQUIREMENTS

A. Gravity loads: Provide aluminum metal fabrications that can support their own weight without buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on sound engineering principles.

B. Lateral load: Aluminum fabrications must also provide support for a wind load equal to 14 PSF and Seismic Forces per the Criteria on S001.

2.9 SUBMITTALS

A. Shop Drawings: Show fabrication and installation details for metal fabrications.

1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
2. Provide templates for anchors and bolts specified for installation under other Sections.
3. Provide calculations showing that installed products and connections comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer licensed in the State of Connecticut, responsible for their preparation.

B. Samples for Verification: For each type and finish of extruded shape.

C. Mill Certificates: Signed by manufacturers of aluminum shapes, certifying that products furnished comply with requirements.

D. Welding certificates.

E. Engineer Qualifications: A professional engineer who is legally authorized to practice in the State of Connecticut and experienced in providing engineering services for the installation and successful in-service performance of aluminum components similar to this Project in material, design and extent.

2.10 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.2, "Structural Welding Code--Aluminum."

2.11 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.
2. Provide allowance for trimming and fitting at site.

2.12 COORDINATION

A. Coordinate installation of anchorages for metal fabrications. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 3 - PRODUCTS

3.6 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces, unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

3.7 NONFERROUS METALS

A. Aluminum Plate and Sheet: ASTM B 209, Alloy 6061-T6.

B. Aluminum Structural Shapes Extrusions: ASTM B 308, Alloy 6061-T6.

3.8 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use. Provide stainless-steel fasteners for fastening aluminum. Select fasteners for type, grade, and class required. Provide lock washer or other locking device at all bolted connections.

B. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, nuts and, where indicated, flat washers; ASTM F 593 for bolts and ASTM F 594 for nuts, Alloy Group 1.

C. Aluminum bolts are acceptable for fastening aluminum parts. Provide alloy and temper 6061-T6, or 7075-T73. Finish for exposed aluminum fasteners shall be the same as for the aluminum parts being fastened. Provide lock washer or other locking device at all bolted connections.

D. Expansion Anchors: Anchor bolt and sleeve assembly with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
   1. Material for Anchors: Alloy Group 1 stainless-steel bolts complying with ASTM F 593 and nuts complying with ASTM F 594 .

E. Anchor bolts: A193 GR B8M Class 1 Stainless Steel. Heavy Hex Nuts to be A194 GR 8M

3.9 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

C. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

D. Concrete Materials and Properties: Comply with requirements in Division 3 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 4500 psi, unless otherwise indicated.

2.5 TOLERANCES

A. Tolerances in the Aluminum Association Aluminum Standards and Data 2000 are applicable to finished, fabricated and assembled materials. Maintain stricter tolerances where required for proper fit of components.

1. FABRICATION, GENERAL

E. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

F. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch, unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

G. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

H. Form exposed work true to line and level with accurate angles and surfaces and straight edges.

I. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

J. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts, unless otherwise indicated. Locate joints where least conspicuous.

K. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

L. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

M. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

3.10 ALUMINUM FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

C. High-Performance Organic Finish (2-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: conversion coating; Organic Coating: manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer, fluoropolymer topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight).
Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2605 and with coating and resin manufacturers' written instructions.

1. Basis of Design Color and Gloss: Valspar Fluropon Classic II, Champagne Gold 399A54. Pearlescent/mica finish.

PART 4 - EXECUTION

4.6 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.

4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag bolts, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.

4.7 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

4.8 ADJUSTING AND CLEANING

A. Protect materials against damage and contamination. Clean surfaces as required to remove corrosive substances, during and at conclusion of construction.

B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 9 painting Sections.

END OF SECTION 05 55 00

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. This Section includes the following:

1. Interior steel-supported railings with glass infill, at Atrium walkways, Knuckle balconies, Monumental stair, and Stair2 Ground level.
2. Interior stainless steel chair rails (CR-1).
3. Exterior laser-cut aluminum infill panels and galvanized steel railing at upper roofs.
4. Exterior laser-cut aluminum panel and galvanized steel support at Jennings Entrance (south of generator enclosure).

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 05 51 00 - METAL STAIRS AND RAILINGS for steel stairs, handrails, and guardrails.
2. Section 06 10 00 - ROUGH CARPENTRY for wood blocking for anchoring railings.
3. Section 08 80 00 - GLAZING for glass at railings.
4. Section 09 21 10 - GYPSUM BOARD ASSEMBLIES for metal backing for anchoring railings.

1.3 DEFINITIONS

A. Railings: Guards, handrails, and similar devices used for protection of occupants at open-sided floor areas, pedestrian guidance and support, visual separation, or wall protection.

1.4 PERFORMANCE REQUIREMENTS

A. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:

1. Aluminum: The lesser of minimum yield strength divided by 1.65 or minimum ultimate tensile strength divided by 1.95.
2. Steel: 72 percent of minimum yield strength.
3. Stainless Steel: 60 percent of minimum yield strength.

4. Glass: 25 percent of mean modulus of rupture (50 percent probability of breakage), as listed in "Mechanical Properties" in AAMA's Aluminum Curtain Wall Series No. 12, "Structural Properties of Glass."

B. Structural Performance of Railings: Provide railings capable of withstanding the effects of gravity loads and Code required loads and stresses within limits and under conditions indicated.

C. Thermal Movements: Provide exterior railings that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

D. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Manufacturer's product lines of railings assembled from standard components.
2. Grout, anchoring cement, and paint products.

B. LEED Submittals:

1. Product Data for Credit MR 4: Indicating percentages by weight of postconsumer and preconsumer recycled content for products having recycled content. Include statement indicating costs for each product having recycled content.
2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

D. Samples for Verification: For each type of exposed finish required.

1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
2. Each type of glass required.
3. Fittings and brackets.
4. Welded connections.

5. Assembled Samples of railing systems, made from full-size components, including top rail, post, handrail, and infill. Show method of finishing members at intersections. Samples need not be full height.

E. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.

F. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

G. Welding certificates.

H. Qualification Data: For professional engineer licensed in the jurisdiction where Project is located.

1.6 QUALITY ASSURANCE

A. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a qualified professional engineer.

B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of metal stairs that are similar to those indicated for this Project in material, design, and extent.

C. Installer Qualifications: Fabricator of products.

D. Source Limitations: Obtain each type of railing through one source from a single manufacturer.

E. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2, "Structural Welding Code--Aluminum."
3. AWS D1.6, "Structural Welding Code--Stainless Steel."

F. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockups for each form and finish of railing consisting of two posts, top rail, infill area, and anchorage system components that are full height and are not less than 24 inches (600 mm) in length.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating railings without field

measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.

1.8 COORDINATION AND SCHEDULING

A. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

B. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Steel and Glass Railings:
   a. Blum, Julius & Co., Inc.
   b. Blumcraft of Pittsburgh.
   c. Lawler Foundry Corporation.
   d. Livers Bronze Co.
   e. Wagner, R & B, Inc.; a division of the Wagner Companies.

2. Stainless-Steel:
   a. Blum, Julius & Co., Inc.
   b. Blumcraft of Pittsburgh.
   c. Livers Bronze Co.
   d. Wagner, R & B, Inc.; a division of the Wagner Companies.

2.2 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

2.3 ALUMINUM

A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with strength and durability properties for each aluminum form required not less than that of alloy and temper designated below.

B. Plate and Sheet: ASTM B 209, Alloy 6061-T6.

2.4 STEEL

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Tubing: ASTM A 500 (cold formed) or ASTM A 513.

C. Bars: Hot-rolled, carbon steel complying with ASTM A 29/A 29M, Grade 1010.

D. Plates, Shapes, and Bars: ASTM A 36/A 36M.

2.5 STAINLESS STEEL

A. Tubing: ASTM A 554, Grade MT 304 at interior locations.

B. Pipe: ASTM A 312, Grade TP 304 at interior locations.

C. Castings: ASTM A 743, Grade CF 8 or CF 20.

D. Plate and Sheet: ASTM A 666, Type 304 at interior locations.

2.6 GLASS AND GLAZING MATERIALS

A. Glass: Provide as specified in Section 08 80 00 - GLAZING.

2.7 WOOD RAILINGS

A. Wood Rails: Provide as specified in Section 06 40 20 - INTERIOR ARCHITECTURAL WOODWORK.

2.8 ALUMINUM INFILL PANELS

A. Infill Panels: Provide aluminum infill panels laser cut to pattern indicated on the Drawings. Factory finish after fabrication.

2.9 FASTENERS

A. General: Provide the following:

1. Aluminum Components: Type 316 stainless-steel fasteners.
2. Galvanized-Steel Components: Plated-steel fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating.
3. Stainless-Steel Components: Type 316 stainless-steel fasteners.
4. Dissimilar Metals: Type 316 stainless-steel fasteners.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

C. Provide concealed fasteners for interconnecting railing components and for attaching railings to other work, unless exposed fasteners are the standard fastening method for railings indicated.

D. Anchors: Provide anchors, fabricated from corrosion-resistant materials with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

2.10 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

1. For aluminum, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.

B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

C. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.11 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch, unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Form changes in direction as detailed on the Drawings and as standard with system selected.

H. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work, unless otherwise indicated.

1. At brackets and fittings fastened to plaster or gypsum board partitions, provide fillers made from crush-resistant material, or other means to transfer wall loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.

I. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

2.12 GLAZING PANEL FABRICATION

A. General: Fabricate to sizes and shapes required; provide for proper edge clearance and bite on glazing panels.

B. Structural Glass Balusters: Factory-bond glass to aluminum base and top-rail channels in railing manufacturer's plant using glazing cement to comply with manufacturer's written specifications, unless field glazing is standard with manufacturer.

C. Apply ceramic linework on glass to comply with GANA's "Engineering Standards Manual."

2.13 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish metal fabrications after assembly.

2.14 ALUMINUM FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

C. High-Performance Organic Finish (3-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: conversion coating; Organic Coating: manufacturer's standard 3-coat, thermocured system consisting of specially formulated inhibitive primer, fluoropolymer color coat, and clear fluoropolymer topcoat, with both color coat and clear topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2605 and with coating and resin manufacturers' written instructions.

1. Color and Gloss: Valspar Fluropon Classic II, Champagne Gold, Pearlescent/Mica Fleck.

2.15 HOT-DIP GALVANIZING AND FACTORY-APPLIED ARCHITECTURAL FINISH

A. Hot-Dip Galvanizing: For steel exposed to the elements, weather or corrosive environments and other steel indicated to be galvanized, provide coating for iron and steel fabrications applied by the hot-dip process.

1. Basis-of-Design: Duragalv by Duncan Galvanizing.
2. Comply with ASTM A 123 for fabricated products and ASTM A 153 for hardware.
3. Provide thickness of galvanizing specified in referenced standards.
4. Galvanizing bath shall contain special high grade zinc and other earthly materials.
5. Fill vent holes after galvanizing, if applicable, and grind smooth.

B. Hot-Dip Galvanizing: For steel exposed to the elements, weather or corrosive environments and other steel indicated to be galvanized, provide coating for iron and steel fabrications applied by the hot-dip process.

1. Basis-of-Design: Colorgalv by Duncan Galvanizing.

2. Primer coat shall be factory-applied polyamide epoxy primer. Apply primer within 12 hours after galvanizing at the same galvanizer's plant in a controlled environment meeting applicable environmental regulations and as recommended by the primer coating manufacturer.
3. Finish coat shall be factory-applied color-pigmented architectural finish. Apply finish coating at the galvanizer's plant, in a controlled environment meeting applicable environmental regulations and as recommended by the finish coating manufacturer. Finish coat shall exhibit a rugosity (smoothness) not greater than 4 rug (16-20 microns of variation) when measured by a profilometer over a 1 inch straight line on the surface of architectural and structural elements that are less than 24 pounds per running foot. Profilometer shall be capable of operating in 1 micron increments.
4. Coatings shall be certified OTC/VOC compliant and conform to applicable regulations and EPA standards.
5. Apply the galvanizing, primer, and coating within the same facility and provide single-source responsibility for galvanizing, priming and finish coating.
6. Clean galvanized surface to create an acceptable profile for coatings. Galvanizer shall certify that performance will be met without blast cleaning and coating will be applied within 12 hours of galvanizing at the galvanizer's plant. If blasted, galvanizer shall certify that rugosity standards are met.
7. Primer shall meet or exceed the following performance criteria:
   a. Abrasion Resistance per ASTM D 4060 (CS17 Wheel, 1,000 grams load),1kg Load: 200 mg loss.
   b. Adhesion per ASTM D4541: 1050 psi.
   c. Corrosion Weathering per ASTM D5894, 13 Cycles, 4,368 Hours: Rating 10 per ASTM D714 for blistering; Rating 7 per ASTM D610 for rusting.
   d. Direct Impact Resistance per ASTM D2794: 160 in. lbs.
   e. Flexibility per ASTM D522, 180º Bend, 1 in. Mandrel: Passes.
   f. Pencil Hardness per ASTM D3363: 3B.
   g. Moisture Condensation Resistance per ASTM D4585, 100ºF, 2000 Hours: Passes, no cracking or delamination.
   h. Dry Heat Resistance per ASTM D2485: 250ºF.
8. Topcoat shall meet or exceed the following performance criteria:
   a. Abrasion Resistance per ASTM D 4060, CS17 Wheel, 1,000 Cycles 1kg Load: 87.1 mg loss.
   b. Adhesion per ASTM D 4541: 1050 psi.
   c. Direct Impact Resistance per ASTM D2794: >28 in. pounds.
   d. Indirect Impact Resistance per ASTM D2794: 12-14 in. pounds.
   e. Dry Heat Resistance per ASTM D2485: 200°F.
   f. Salt Fog Resistance per ASTM B 117 9,000 Hours: Rating 10 per ASTM D714 for blistering.
   g. Flexibility per ASTM D522, 180° Bend, 1/8 in. Mandrel: Passes.
   h. Pencil Hardness per ASTM D3363: 2H.
   i. Moisture Condensation Resistance per ASTM D4585, 100°F, 1000 Hours: No blistering or delamination Xenon Arc Test per ASTM D 4798: Pass 300 hours

2.16 STAINLESS-STEEL FINISHES

A. Remove tool and die marks and stretch lines or blend into finish.

B. Grind and polish surfaces to produce uniform finish indicated, free of cross scratches.

1. Run grain of directionally textured finishes with long dimension of each piece.

C. Directional Satin Finish: No. 4.

D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.

C. Corrosion Protection: Coat concealed surfaces of aluminum and copper alloys that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

D. Adjust railings before anchoring to ensure matching alignment at abutting joints.

E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.3 ANCHORING POSTS

A. Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with [nonshrink, nonmetallic grout] [or] [anchoring cement], mixed and placed to comply with anchoring material manufacturer's written instructions.

B. Form or core-drill holes not less than 5 inches deep and 3/4 inch larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.

C. Cover anchorage joint with flange of same metal as post, attached to post with set screws.

D. Leave anchorage joint exposed; wipe off surplus anchoring material; and leave 1/8-inch buildup, sloped away from post.

E. Anchor steel posts to steel with flanges, angle or floor type as required by conditions, welded to posts and bolted to metal supporting members.

F. Anchor posts to metal surfaces with flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:

1. For stainless-steel railings, weld flanges to posts and bolt to metal-supporting surfaces.

3.4 ANCHORING RAILING ENDS

A. Anchor railing ends to concrete and masonry as indicated on the drawings and anchored to wall construction with anchors and bolts.

B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces.

3.5 ATTACHING HANDRAILS TO WALLS

A. Attach handrails to walls with wall brackets. Provide brackets with 1-1/2-inch clearance from inside face of handrail and finished wall surface.

B. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

C. Secure wall brackets to building construction as follows:

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
2. For hollow masonry anchorage, use toggle bolts.
3. For steel-framed partitions, fasten brackets directly to steel framing or concealed steel reinforcements using self-tapping screws of size and type required to support structural loads.

3.6 INSTALLING GLASS PANELS

A. Post-Supported Glass Railings: Install assembly to comply with railing manufacturer's written instructions and with requirements in other Part 3 articles. Erect posts and other metal railing components, then set factory-cut glass panels. Do not cut, drill, or alter glass panels in field. Protect edges from damage.

3.7 CLEANING

A. Clean railings as recommended by finish fabricator.

B. Clean and polish glass.

3.8 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in field to shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 05 73 00

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Decorative steel brackets at sunshade canopies (S1) with galvanized architectural finish.
2. Aluminum finials at rainwater leaders' downspouts at Knuckle south Vestibule.
3. Aluminum downspout covers at Knuckle south Vestibule.
4. Aluminum downspout covers and decorative elbows.
5. Laser-cut stainless steel corner guards (CG-2).

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 05 50 00 - METAL FABRICATIONS for non-ornamental metal fabrications.
2. Section 05 73 00 - DECORATIVE METAL RAILINGS for ornamental metal railings.
3. Section 07 42 00 - METAL WALL PANELS for perforated panels at parapet.
4. Section 07 61 00 - SHEET METAL ROOFING for items made of formed metal for roofing and for items made of formed metal for parapets and copings
5. Section 07 62 00 - SHEET METAL FLASHING AND TRIM for items made of formed metal for flashings.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Loads: Capable of withstanding the following structural loads without exceeding the allowable design working stress of materials involved, including anchors and connections, and without exhibiting permanent deformation in any components:

1. Wind Loads on Exterior Items: As indicated on Structural Drawings.

B. Thermal Movements: Provide exterior ornamental formed-metal assemblies that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

C. Corrosion Control: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated, including finishes.

B. LEED Submittals:

1. Product Data for Credit MR 4: Indicating percentages by weight of postconsumer and preconsumer recycled content for products having recycled content. Include statement indicating costs for each product having recycled content.
2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.
3. Product Data for Credit IEQ 4.1: For adhesives and sealants, including printed statement of VOC content.

C. Shop Drawings: Show fabrication and installation details for formed metal fabrications.

1. Include plans, elevations, sections, and details of formed metal fabrications and their connections. Show anchorage and accessory items.
2. Provide templates for anchors and bolts specified for installation under other Sections.
3. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer licensed in the jurisdiction where Project is located responsible for their preparation.
4. Where fabrications are to receive sprayed-on fireproofing, include statement that primer is compatible with fireproofing proposed for use.

D. Samples for Initial Selection: Manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, including mechanical finishes, and patterns available for each type of ornamental formed-metal product indicated.

E. Samples for Verification: For each type of exposed finish required, prepared on 6-inch-square samples of metal of same thickness and material indicated for the Work.

F. Welding certificates.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: A firm experienced in producing ornamental formed metal similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

1. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.

B. Anodic Finisher Qualifications: A firm experienced in successfully applying anodic finishes of type indicated and employing competent control personnel to conduct continuing, effective quality-control program to ensure compliance with requirements.

C. Source Limitations: Obtain each ornamental formed-metal item through one source from a single manufacturer.

D. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.2, "Structural Welding Code - Aluminum."
2. AWS D1.6, "Structural Welding Code - Stainless Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver ornamental formed-metal products wrapped in protective coverings and strapped together in suitable packs or in heavy-duty cartons. Remove protective coverings before they stain or bond to finished surfaces.

B. Store products on elevated platforms in a dry location.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls, columns, beams, and other construction contiguous with ornamental formed metal by field measurements before fabrication and indicate measurements on Shop Drawings.

1.8 COORDINATION

A. Coordinate installation of anchorages for ornamental formed-metal items. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

B. Coordinate installation of ornamental formed metal with adjacent construction to ensure that wall assemblies, flashings, trim, and joint sealants, are protected against damage from the effects of weather, age, corrosion, and other causes.

PART 2 - PRODUCTS

2.1 METAL

A. General: Provide sheet metal without pitting, seam marks, roller marks, stains, discolorations, or other imperfections where exposed to view on finished units.

B. Aluminum Sheet: Flat sheet complying with ASTM B 209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than strength and durability properties of alloy 5005-H32.

C. Aluminum Extruded Bars and Shapes: ASTM B 221, Alloy 6063-T5/T52.

D. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304 for interior and Type 316 for exterior, stretcher-leveled standard of flatness.

E. Steel Sheet: Uncoated, cold-rolled, ASTM A 1008/A 1008M, commercial steel, exposed.

2.2 MISCELLANEOUS MATERIALS

A. Gaskets: As required to seal joints in ornamental formed metal and remain weathertight; and as recommended in writing by ornamental formed-metal manufacturer.

1. ASTM D 1056, Type 1, Class A, grade as recommended by gasket manufacturer to obtain seal for application indicated.
2. Closed cell polyurethane foam, adhesive on two sides, release paper protected.

B. Filler Metal and Electrodes: Provide type and alloy of filler metal and electrodes as recommended by producer of metal to be welded or brazed and as necessary for strength, corrosion resistance, and compatibility in fabricated items.

1. Use filler metals that will match the color of metal being joined and will not cause discoloration.

C. Fasteners: Use fasteners fabricated from same basic metal and alloy as fastened metal, unless otherwise indicated. Do not use metals that are corrosive or incompatible with materials joined.

1. Provide concealed fasteners for interconnecting ornamental formed-metal items and for attaching them to other work.
2. Provide Phillips flat-head machine screws for exposed fasteners, unless otherwise indicated.

D. Structural Anchors: For applications indicated to comply with certain design loads, provide anchors fabricated from corrosion-resistant materials with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

E. Nonstructural Anchors: For applications not indicated to comply with design loads, provide anchors of type, size, and material necessary for type of load and installation indicated, as recommended by manufacturer, unless otherwise indicated. Use nonferrous-metal or hot-dip galvanized anchors for exterior installations and elsewhere as needed for corrosion resistance.

F. Sound-Deadening Materials:

1. Insulation: Unfaced, mineral-fiber blanket insulation complying with ASTM C 665, Type I, and passing ASTM E 136 test.
2. Mastic: Cold-applied asphalt emulsion complying with ASTM D 1187.

G. Backing Materials: Provided or recommended by ornamental formed-metal manufacturer.

H. Laminating Adhesive: Compatible with substrate; noncombustible after curing.

1. Contact Adhesive: VOC content of not more than 80 g/L when calculated according to 40 CFR 59, Subpart D (EPA method 24).

2. Metal-to-Metal Adhesive: VOC content of not more than 30 g/L when calculated according to 40 CFR 59, Subpart D (EPA method 24).
3. Multi-Purpose Construction Adhesive: VOC content of not more than 70 g/L when calculated according to 40 CFR 59, Subpart D (EPA method 24).
4. Special-Purpose Contact Adhesive (contact adhesive used to bond melamine-covered board, metal, unsupported vinyl, Teflon, ultra-high molecular weight polyethylene, and rubber or wood veneer, 1/16 inch or less in thickness, to any surface): 250 g/L.

I. Isolation Coating: Manufacturer's standard bituminous paint.

2.3 PAINTS AND COATINGS

A. Shop Primers: Provide primers that comply with Section 09 90 00 - PAINTING

B. Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI # 79.

C. Zinc-Rich Primer: Complying with SSPC-Paint 20 or 29 and compatible with finish paint systems indicated.

1. Provide interior, field-applied primer with a VOC content of 250 g/L or less, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Shop Primer for Galvanized Steel: Zinc-dust, zinc-oxide primer formulated for priming zinc-coated steel and for compatibility with finish paint systems indicated; complying with SSPC-Paint 5.

E. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

1. Provide interior, field-applied paint with a VOC content of 250 g/L or less, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 FABRICATION, GENERAL

A. Shop Assembly: Preassemble ornamental formed-metal items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Coordinate dimensions and attachment methods of ornamental formed-metal items with those of adjoining construction to produce integrated assemblies with closely fitting joints and with edges and surfaces aligned, unless otherwise indicated.

C. Form metal to profiles indicated, in maximum lengths to minimize joints. Produce flat, flush surfaces without cracking or grain separation at bends. Fold back exposed edges of unsupported sheet metal to form a 1/2-inch-wide hem on the concealed side, or ease edges to a radius of approximately 1/32 inch and support with concealed stiffeners.

D. Form decorative metal to required shapes and sizes, true to line and level with true curves and accurate angles and surfaces. Finish exposed surfaces to smooth, sharp, well-defined lines and arris.

E. Increase metal thickness or reinforce with concealed stiffeners, backing materials, or both, as needed to provide surface flatness equivalent to stretcher-leveled standard of flatness and sufficient strength for indicated use.

1. Support joints with concealed stiffeners as needed to hold exposed faces of adjoining sheets in flush alignment.

F. Build in straps, plates, and brackets as needed to support and anchor fabricated items to adjoining construction. Reinforce ornamental formed-metal items as needed to attach and support other construction.

G. Provide support framing, mounting and attachment clips, splice sleeves, fasteners, and accessories needed to install ornamental formed-metal items.

H. Where welding or brazing is indicated, weld or braze joints and seams continuously. Grind, fill, and dress to produce smooth, flush, exposed surfaces in which joints are not visible after finishing is completed.

1. Use welding and brazing procedures that will blend with and not cause discoloration of metal being joined.

2.5 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for steel sheet finishes.

C. Complete mechanical finishes of flat sheet metal surfaces before fabrication where possible. After fabrication, finish all joints, bends, abrasions, and other surface blemishes to match sheet finish.

D. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

E. Apply organic and anodic finishes to formed metal after fabrication, unless otherwise indicated.

F. Finish items after assembly.

G. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.6 ALUMINUM FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

C. High-Performance Organic Finish (2-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: conversion coating; Organic Coating: manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color coat, with color coat containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2605 and with coating and resin manufacturers' written instructions.

1. Color and Gloss: Valspar Fluropon Classic II, Champagne Gold, Pearlescent/Mica Fleck.

2.7 STAINLESS-STEEL FINISHES

A. Remove tool and die marks and stretch lines or blend into finish.

B. Grind and polish surfaces to produce uniform, polished finish indicated, free of cross scratches.

1. Run grain of directionally textured finishes with long dimension of each piece.

C. Directional Satin Finish: No. 4 finish.

D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

2.8 STEEL SHEET FINISHES

A. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or with SSPC-SP 8, "Pickling."

B. Pretreatment: Immediately after cleaning, apply a conversion coating of type suited to organic coating applied over it.

C. Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard thermosetting polyester or acrylic urethane powder coating with cured-film thickness not less than 1.5 mils. Prepare, treat, and coat metal to comply with resin manufacturer's written instructions.

1. Color and Gloss: As selected by Architect.

2.9 HOT-DIP GALVANIZING AND FACTORY-APPLIED ARCHITECTURAL FINISH

A. Hot-Dip Galvanizing: For steel exposed to the elements, weather or corrosive environments and other steel indicated to be galvanized, provide coating for iron and steel fabrications applied by the hot-dip process.

1. Basis-of-Design: Duragalv by Duncan Galvanizing.
2. Comply with ASTM A 123 for fabricated products and ASTM A 153 for hardware.
3. Provide thickness of galvanizing specified in referenced standards.
4. Galvanizing bath shall contain special high grade zinc and other earthly materials.

5. Fill vent holes after galvanizing, if applicable, and grind smooth.

B. Architectural Finish: For steel exposed to the elements, weather or corrosive environments and other steel indicated to be galvanized, provide coating for iron and steel fabrications applied by the hot-dip process.

1. Basis-of-Design: Colorgalv by Duncan Galvanizing.
2. Primer coat shall be factory-applied polyamide epoxy primer. Apply primer within 12 hours after galvanizing at the same galvanizer's plant in a controlled environment meeting applicable environmental regulations and as recommended by the primer coating manufacturer.
3. Finish coat shall be factory-applied color-pigmented architectural finish. Apply finish coating at the galvanizer's plant, in a controlled environment meeting applicable environmental regulations and as recommended by the finish coating manufacturer. Finish coat shall exhibit a rugosity (smoothness) not greater than 4 rug (16-20 microns of variation) when measured by a profilometer over a 1 inch straight line on the surface of architectural and structural elements that are less than 24 pounds per running foot. Profilometer shall be capable of operating in 1 micron increments.
4. Coatings shall be certified OTC/VOC compliant and conform to applicable regulations and EPA standards.
5. Apply the galvanizing, primer, and coating within the same facility and provide single-source responsibility for galvanizing, priming and finish coating.
6. Clean galvanized surface to create an acceptable profile for coatings. Galvanizer shall certify that performance will be met without blast cleaning and coating will be applied within 12 hours of galvanizing at the galvanizer's plant. If blasted, galvanizer shall certify that rugosity standards are met.
7. Primer shall meet or exceed the following performance criteria:
   a. Abrasion Resistance per ASTM D 4060 (CS17 Wheel, 1,000 grams load),1kg Load: 200 mg loss.
   b. Adhesion per ASTM D4541: 1050 psi.
   c. Corrosion Weathering per ASTM D5894, 13 Cycles, 4,368 Hours: Rating 10 per ASTM D714 for blistering; Rating 7 per ASTM D610 for rusting.
   d. Direct Impact Resistance per ASTM D2794: 160 in. lbs.
   e. Flexibility per ASTM D522, 180º Bend, 1 in. Mandrel: Passes.
   f. Pencil Hardness per ASTM D3363: 3B.
   g. Moisture Condensation Resistance per ASTM D4585, 100ºF, 2000 Hours: Passes, no cracking or delamination.
   h. Dry Heat Resistance per ASTM D2485: 250ºF.
8. Topcoat shall meet or exceed the following performance criteria:
   a. Abrasion Resistance per ASTM D 4060, CS17 Wheel, 1,000 Cycles 1kg Load: 87.1 mg loss.
   b. Adhesion per ASTM D 4541: 1050 psi.
   c. Direct Impact Resistance per ASTM D2794: >28 in. pounds.
   d. Indirect Impact Resistance per ASTM D2794: 12-14 in. pounds.
   e. Dry Heat Resistance per ASTM D2485: 200°F.
   f. Salt Fog Resistance per ASTM B 117 9,000 Hours: Rating 10 per ASTM D714 for blistering.
   g. Flexibility per ASTM D522, 180° Bend, 1/8 in. Mandrel: Passes.
   h. Pencil Hardness per ASTM D3363: 2H.
   i. Moisture Condensation Resistance per ASTM D4585, 100°F, 1000 Hours: No blistering or delamination Xenon Arc Test per ASTM D 4798: Pass 300 hours.

C. Color: Custom color to match Architect's sample.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of ornamental formed metal.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Locate and place ornamental formed-metal items level and plumb and in alignment with adjacent construction.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where needed to protect metal surfaces and to make a weathertight connection.

C. Form tight joints with exposed connections accurately fitted together. Provide reveals and openings for sealants and joint fillers as indicated.

D. Install concealed gaskets, joint fillers, insulation, sealants, and flashings, as the Work progresses, to make exterior ornamental formed-metal items weatherproof.

E. Install concealed gaskets, joint fillers, sealants, and insulation, as the Work progresses, to make interior ornamental formed-metal items soundproof or lightproof as applicable to the type of fabrication indicated.

F. Corrosion Protection: Apply nonmelting/nonmigrating-type bituminous coating or other permanent separation materials on concealed surfaces where metals would otherwise be in direct contact with substrate materials that are incompatible or could result in corrosion or deterioration of either material or finish.

3.3 ADJUSTING

A. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit or provide new units.

3.4 PROTECTION

A. Protect finishes of ornamental formed-metal items from damage during construction period. Remove temporary protective coverings at time of Substantial Completion.

END OF SECTION 05 75 00

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Wood blocking, cants, and nailers.
2. Plywood backing panels.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 04 20 00 - UNIT MASONRY for wood nailers and blocking built into masonry.
2. Section 06 16 00 - SHEATHING for gypsum sheathing.
3. Section 06 40 20 - INTERIOR ARCHITECTURAL WOODWORK for interior woodwork not specified in this Section.

1.3 SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used, net amount of preservative retained, and chemical treatment manufacturer's written instructions for handling, storing, installing, and finishing treated material.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials, both before and after exposure to elevated temperatures when tested according to ASTM D 5516 and ASTM D 5664.
3. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
4. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

B. LEED Submittals:

1. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.
2. Certificates for Credit MR 7: Chain-of-custody certificates indicating that products specified to be made from certified wood comply with forest certification requirements. Include documentation that manufacturer is certified for chain of custody by an FSC-accredited certification body. Include statement indicating cost for each certified wood product.
3. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.
4. Product Data for Credit IEQ 4.4: For composite wood products, documentation indicating that product contains no added urea formaldehyde.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber, plywood, and other panels; place spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Certified Wood: Materials shall be produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship**."**

B. Lumber: DOC PS 20 and applicable rules of lumber grading agencies certified by the American Lumber Standards Committee Board of Review.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
3. Provide dressed lumber, S4S, unless otherwise indicated.
4. Provide dry lumber with 15 percent maximum moisture content at time of dressing for 2-inch nominal thickness or less, unless otherwise indicated.

C. Plywood Panels:

1. Plywood: Either DOC PS 1 or DOC PS 2, unless otherwise indicated.
2. Thickness: As needed to comply with requirements specified but not less than thickness indicated.

3. Factory mark panels according to indicated standard.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.
2. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.

B. Kiln-dry material after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood. Do not use material that is warped or does not comply with requirements for untreated material.

C. Mark each treated item with the treatment quality mark of an inspection agency approved by the American Lumber Standards Committee Board of Review.

D. Application: Treat items indicated on Drawings, and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete in exterior walls.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. Blocking at Exterior Walls: Provide materials that are fire-retardant treated and comply with performance requirements in AWPA C20 (lumber) and AWPA C27 (plywood). Identify fire-retardant-treated wood with appropriate classification marking of UL, U.S. Testing, Timber Products Inspection, or another testing and inspecting agency acceptable to authorities having jurisdiction.

1. Use treatment for which chemical manufacturer publishes physical properties of treated wood after exposure to elevated temperatures, when tested by a qualified independent testing agency according to ASTM D 5664, for lumber and ASTM D 5516, for plywood.
2. Use treatment that does not promote corrosion of metal fasteners.

2.4 MISCELLANEOUS LUMBER

A. General: Provide lumber for support or attachment of other construction, including the following:

1. Rooftop equipment bases and support curbs.
2. Blocking.
3. Cants.
4. Nailers.
5. Furring.
6. Grounds.

B. For items of dimension lumber size, provide Construction, Stud, or No. 2 grade lumber with 15 percent moisture content.

2.5 PANEL PRODUCTS

A. Miscellaneous Concealed Plywood: Exposure 1 sheathing, span rating to suit framing in each location, and thickness as indicated but not less than 1/2 inch.

B. Telephone and Electrical Equipment Backing Panels: DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than 1/2 inch thick.

2.6 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.

1. Where carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide stainless steel fasteners.

B. Nails, Wire, Brads, and Staples: FS FF-N-105.

C. Power-Driven Fasteners: CABO NER-272.

D. Wood Screws: ASME B18.6.1.

E. Screws for Fastening to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

F. Bolts: Steel bolts complying with ASTM A 307, Grade A with ASTM A 563 hex nuts and, where indicated, flat washers.

G. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.

1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.

2.7 MISCELLANEOUS MATERIALS

A. Adhesive, Including Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.

1. Use adhesives that have a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Discard units of material with defects that impair quality of carpentry and that are too small to use with minimum number of joints or optimum joint arrangement.

B. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.

C. Apply field treatment complying with AWPA M4 to cut surfaces of preservative-treated lumber and plywood.

D. Securely attach carpentry work as indicated and according to applicable codes and recognized standards, including Factory Mutual FM 1-49.

E. Countersink fastener heads on exposed carpentry work and fill holes with wood filler.

F. Use fasteners of appropriate type and length. Predrill members when necessary to avoid splitting wood.

3.2 WOOD BLOCKING, AND NAILER INSTALLATION

A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated.

END OF SECTION 06 10 00

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Gypsum sheathing attached to cold-formed metal framing members at exterior wall.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 05 40 00 - COLD-FORMED METAL FRAMING for metal framing at exterior wall.
2. Section 06 10 00 - ROUGH CARPENTRY for plywood backing panels and fire-retardant-treated blocking at exterior walls.
3. Section 07 27 00 - AIR BARRIERS for modified bituminous sheet membrane over gypsum sheathing and membrane flashing.
4. Section 07 61 00 – SHEET METAL ROOFING for sheathing under sheet metal roofing.
5. Section 07 62 00 - SHEET METAL FLASHING AND TRIM for flashing applied to gypsum sheathing.

1.3 DEFINITIONS

A. Gypsum Board Construction Terminology Standard: Refer to ASTM C 11 and GA-505 for definitions of terms for gypsum sheathing board construction not defined in this Section or in other referenced standards.

1.4 SUBMITTALS

A. Product Data: For each product specified.

B. LEED Submittals:

1. Product Data for Credit MR 4: Indicating percentages by weight of postconsumer and preconsumer recycled content for products having recycled content. Include statement indicating costs for each product having recycled content.
2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of

material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each gypsum sheathing product through one source from a single manufacturer.

B. Fire-Resistance-Rated Assemblies: Where gypsum sheathing boards are part of fire-resistance-rated assemblies, provide assemblies as follows:

1. Assemblies comply with requirements of fire-response-tested assemblies indicated by GA File Numbers in GA-600, "Fire Resistance Design Manual"; or by design designations in UL's "Fire Resistance Directory" or in certification listings of another testing and inspecting agency acceptable to authorities having jurisdiction.
2. Fire-resistance ratings were determined by fire-response testing assemblies according to ASTM E 119.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages, containers, or bundles, each bearing brand name and identification of manufacturer.

B. Store materials protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, or other causes. Neatly stack gypsum sheathing board flat on leveled supports off the ground, under cover, and fully protected from weather.

1.7 SEQUENCING AND SCHEDULING

A. Sequence installing sheathing with installing exterior cladding to comply with requirements indicated below:

1. Do not leave glass-mat gypsum sheathing board exposed to weather for more than 180 days.

PART 2 - PRODUCTS

2.1 SHEATHING BOARD

A. Glass-Mat Gypsum Sheathing Board: ASTM C 1177.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. CertainTeed Corp.; GlasRoc.
b. Georgia-Pacific Gypsum LLC; Dens-Glass Gold.
c. National Gypsum Company; Gold Bond, e^2XP.
d. USG Corporation; Securock.

2. Type and Thickness: 5/8 inch, Type X.

2.2 FASTENERS

A. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing board to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.

1. For steel framing from 0.033 to 0.112 inch thick, attach sheathing to comply with ASTM C 954.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install gypsum sheathing to comply with GA-253 and manufacturer's written instructions.

B. Cut boards at penetrations, edges, and other obstructions of the work; fit tightly against abutting construction, except provide a 3/8-inch setback where non-load-bearing construction abuts structural elements.

C. Coordinate sheathing installation with flashing and joint sealant installation so these materials are installed in the sequence and manner that prevent exterior moisture from passing through completed exterior wall assembly.

D. Coordinate and comply with membrane roofing manufacturer’s requirements for installation of sheathing, insulation and coverboard.

E. Apply fasteners so screw heads bear tightly against face of sheathing boards but do not cut into facing.

F. Do not bridge building expansion joints with sheathing; cut and space edges to match spacing of structural support elements.

G. Vertical Installation: Install 48-inch- wide gypsum sheathing boards vertically with vertical edges centered over flanges of steel studs. Abut ends and edges of each board with those of adjacent boards. Screw-attach boards at perimeter and within field of board to each steel stud:

1. Perimeter: 6 inches on center.
2. Field: 8 inches on center.

END OF SECTION 06 16 00

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Standing and running trim, including wood handrails and wood caps at railings.
2. Wood casework.
   a. Fixed tables in classrooms.
   b. Display cases.
   c. Benches.
   d. Study/work carrels.
3. Plastic-laminate casework.
4. Plastic-laminate countertops.
5. Solid-surfacing-material countertops.
6. Closet and utility shelving.
7. Shop finishing of interior woodwork.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 05 73 00 - DECORATIVE METAL RAILINGS for railings to receive wood rails and caps.
2. Section 06 10 00 - ROUGH CARPENTRY for wood furring, blocking, shims, and hanging strips required for installing woodwork and concealed within other construction before woodwork installation.

1.3 SUBMITTALS

A. Product Data: For each type of product specified, including casework hardware and accessories, and finishing materials and processes.

1. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content
   a. Include statement indicating costs for each product having recycled content.
2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.
3. Certificates for Credit MR 7: Chain-of-custody certificates certifying that products specified to be made from certified wood comply with forest certification requirements. Include evidence that mill is certified for chain of custody by an FSC-accredited certification body.
   a. Include statement indicating costs for each certified wood product.
4. Product Data for Credit IEQ 4.1: For installation adhesives, including printed statement of VOC content.
5. Product Data for Credit IEQ 4.4:
   a. For each composite-wood product used, documentation indicating that the bonding agent contains no urea formaldehyde.
   b. For each adhesive used, documentation indicating that the adhesive contains no urea formaldehyde.

C. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

1. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
2. Show locations and sizes of cutouts and holes for plumbing fixtures, electrical components and other items installed in architectural woodwork.
3. Show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.

D. Samples for Verification:

1. Lumber with or for transparent finish, not less than 5 inches wide by 12 inches long for each species and cut, finished on 1 side and 1 edge.
2. Veneer leaves representative of and selected from flitches to be used for transparent-finished woodwork.
3. Lumber and panel products with shop-applied opaque finish, 5 inches wide by 12 inches long for lumber and 8 by 10 inches for panels, for each finish system and color, with 1/2 of exposed surface finished.
4. Plastic laminates, 8 by 10 inches for each type, color, pattern, and surface finish, with 1 sample applied to core material, and specified edge material applied to 1 edge.
5. Solid-surfacing materials, 6 inches square.

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

B. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production of interior architectural woodwork with sequence-matched wood veneers.

C. Quality Standard: Unless otherwise indicated, comply with AWI/AWMAC/WI's "Architectural Woodwork Standards" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.

D. Fire-Test-Response Characteristics: Where fire-retardant materials or products are indicated, provide materials and products with specified fire-test-response characteristics as determined by testing identical products per test method indicated by UL, ITS, or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify with appropriate markings of applicable testing and inspecting agency in the form of separable paper label or, where required by authorities having jurisdiction, imprint on surfaces of materials that will be concealed from view after installation.

E. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.
2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating woodwork without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.7 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Recycled Content of Medium-Density Fiberboard and Particleboard: Provide products with an average recycled content so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.

B. Certified Wood: Materials shall be produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship**."**

C. General: Provide materials that comply with requirements of AWI/AWMAC/WI's "Architectural Woodwork Standards" for each type of woodwork and quality grade specified, unless otherwise indicated.

D. Wood Veneers and Lumber: Provide AWI Premium Grade materials and workmanship.

1. Provide AWI Lumber Grade 1 and AWI Grade A Veneer, book-matched, minimum 6 inch face veneer width. Kiln dry to 6-8 percent moisture content. Components shall be free of defects and sapwood. Match adjacent pieces for color and grain pattern.
2. Single-Source Requirement for Wood Veneers and Solids: Intent is to provide wood which matches as closely as possible throughout the project. Provide wood veneers and solids from the same distributor, and from the same flitches and solids sources to the greatest extent possible..

E. Wood Species and Cut for Transparent Finish:

1. Wood Species Type 1 (WD-1): White Maple, plain sliced.
2. Wood Species Type 2 (WD-2): Figured Anigre, quarter sawn.

F. Wood Products: Comply with the following:

1. Recycled Content of Medium-Density Fiberboard and Particleboard: Provide products with recycled content.
2. Hardboard: AHA A135.4.
3. Medium-Density Fiberboard: ANSI A208.2, Grade MD, made with binder containing no added urea formaldehyde.
4. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.
5. Softwood Plywood: DOC PS 1, Medium Density Overlay.
6. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1, made with adhesive containing no added urea formaldehyde.

G. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering high-pressure decorative laminates that may be incorporated into the Work include, but are not limited to, the following:

a. Abet Laminati, Inc.
b. Arborite; Division of ITW Canada, Inc.

c. Formica Corporation.
d. Lamin-Art, Inc.
e. Nevamar Company, LLC; Decorative Products Div.
f. Panolam Industries International Incorporated.
g. Wilsonart International; Div. of Premark International, Inc.

2. Colors, Patterns, and Finishes – Basis-of-Design: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

a. PL-1 / Plastic Laminate #1: Formica, Café Welt - 5879 - 58.
b. PL-2 / Plastic Laminate #2: Formica, Earthen Warp - 5880 - 58.
c. PL-3 / Plastic Laminate #3: Chem-Metal, Metal Laminate, Brushed Aluminum #902.
d. PL-4 / Plastic Laminate #4: Formica, Dark Gray - Gloss.

H. Solid-Surfacing Material: Homogeneous solid sheets of filled plastic resin complying with ANSI SS-1 and ISSFA-2.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Avonite, Inc.
b. E. I. du Pont de Nemours and Company.
c. Formica Corporation.
d. LG Chemical, Ltd.
e. Nevamar Company, LLC; Decorative Products Div.
f. Wilsonart International; Div. of Premark International, Inc.

2. Colors, Patterns, and Finishes – Basis-of-Design: Provide materials and products that result in colors of solid-surfacing material complying with the following requirements:

a. SS-1 / Solid Surface #1 - Toilet Rooms: Corian, Green Fleck.
b. SS-2 / Solid Surface #2 - Breakroom #108-F: Corian, White and Beige Fleck.

I. Linoleum Tack and Writing Surfaces: Seamless, homogeneous, self-sealing sheet consisting of granulated cork, linseed oil, resin binders, and dry pigments that are mixed and calendared onto fabric backing; with washable vinyl finish and integral color throughout.

1. Basis-of-Design: L-1 / Linoleum Surface #1: Armstrong, Linorette, LP420 - Serengeti Green.

J. Tempered Float Glass for Casework Doors and Display Cases: ASTM C 1048, Kind FT, Condition A, Type I, Class 1 (clear), Quality-Q3, with exposed edges seamed before tempering, 6 mm thick, unless otherwise indicated. Provide pencil-radius, polished edges at butt glazing.

K. Tempered Float Glass for Casework Shelves: ASTM C 1048, Kind FT, Condition A, Type I, Class 1 (clear), Quality-Q3; with exposed edges seamed before tempering, 6 mm thick.

2.2 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this Article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified.

1. Do not use treated materials that do not comply with requirements of referenced woodworking standard or that are warped, discolored, or otherwise defective.
2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
3. Identify fire-retardant-treated materials with appropriate classification marking of UL, U.S. Testing, Timber Products Inspection, or another testing and inspecting agency acceptable to authorities having jurisdiction.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Comply with performance requirements of AWPA C20 (lumber) and AWPA C27 (plywood). Use the following treatment type:

1. Exterior Type: Organic-resin-based formulation thermally set in wood by kiln drying.
2. Mill lumber before treatment and implement special procedures during treatment and drying processes that prevent lumber from warping and developing discolorations from drying sticks or other causes, marring, and other defects affecting appearance of treated woodwork.
3. Kiln-dry materials before and after treatment to levels required for untreated materials.

C. Fire-Retardant Particleboard: Panels complying with the following requirements, made from softwood particles and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 25 or less per ASTM E 84.

2.3 CASEWORK HARDWARE AND ACCESSORIES

A. General: Provide casework hardware and accessory materials associated with architectural casework, except for items specified in Section 08 71 00 - DOOR HARDWARE.

B. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602,100 degrees of opening, self-closing.

C. Inset Glass Door Hinge at Display Cases - Basis-of-Design: Pivot hinge equal to Sugatsune XL-GL04.

D. Back-Mounted Pulls: BHMA A156.9, B02011.

E. Catches: Push-in magnetic catches, BHMA A156.9, B03131.

F. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081 or BHMA A156.9, B04102; with shelf brackets, B04112.

G. Drawer Slides: BHMA A156.9, B05091; side mounted and extending under bottom edge of drawer; full-extension type; epoxy-coated-steel with steel ball-bearings; of the following grades:

1. Box Drawer Slides: Grade 1.
2. File Drawer Slides: Grade 1HD-100.
3. Pencil Drawer Slides: Grade 2.
4. Keyboard Slides: Grade 1.
5. Trash Bin Slides: Grade 1HD-100.

H. Aluminum Slides for Sliding Glass Doors: BHMA A156.9, B07063.

I. Door Locks: BHMA A156.11, E07121.

J. Glass Door Locks at Display Cases - Basis-of-Design: Equal to Hafele 233.54.901; non-bore, single-door lock.

K. Drawer Locks: BHMA A156.11, E07041.

L. Grommets for Cable Passage through Countertops: Molded-plastic grommets and matching plastic caps with slot for wire passage.

M. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.

1. Satin Stainless Steel: BHMA 630.
2. Satin Aluminum, Clear Anodized: BHMA 628.

N. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

2.4 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated softwood lumber, kiln dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

C. Adhesives, General: Do not use adhesives that contain urea formaldehyde.

D. VOC Limits for Installation Adhesives and Glues: Use installation adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Wood Glues: 30 g/L.
2. Contact Adhesive: 80 g/L.
3. Special Purpose Contact Adhesive: 250 g/L.

2.5 FABRICATION, GENERAL

A. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.

B. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.

C. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:

1. Corners of Casework and Edges of Solid-Wood (Lumber) Members and Rails: 1/16 inch.

D. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

E. Shop-cut openings to maximum extent possible to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

1. Seal edges of openings in countertops with a coat of varnish.

F. Install glass to comply with applicable requirements in Section 08 80 00 - GLAZING and in GANA's "Glazing Manual." For glass in wood frames, secure glass with removable stops.

2.6 INTERIOR STANDING AND RUNNING TRIM FOR TRANSPARENT FINISH

A. Grade: Custom.

B. Wood Species and Cut: As specified hereinabove and as indicated on the Drawings.

1. Provide split species on trim that faces areas with different wood species, matching each face of woodwork to species and cut of finish wood surfaces in areas finished.

C. For trim items wider than available lumber, use veneered construction. Do not glue for width.

D. For rails wider or thicker than available lumber, use veneered construction. Do not glue for width or thickness.

E. Backout or groove backs of flat trim members and kerf backs of other wide, flat members, except for members with ends exposed in finished work.

F. Assemble casings in plant except where limitations of access to place of installation require field assembly.

2.7 WOOD CASEWORK, INCLUDING CARRELS, FOR TRANSPARENT FINISH

A. Grade: Custom.

B. AWI Type of Casework Construction: Flush overlay.

C. Wood Species and Cut for Exposed Surfaces: As specified hereinabove and as indicated on the Drawings.

1. Grain Direction: Vertically for drawer fronts, doors, and fixed panels.
2. Matching of Veneer Leaves: Book match.
3. Vertical Matching of Veneer Leaves: End match.
4. Veneer Matching within Panel Face: Running match.
5. Veneer Matching within Room: Provide casework veneers in each room or other space from a single flitch with doors, drawer fronts, and other surfaces matched in a sequenced set with continuous match where veneers are interrupted perpendicular to the grain.

D. Semiexposed Surfaces: Provide surface materials indicated below:

1. Surfaces Other Than Drawer Bodies: Compatible species to that indicated for exposed surfaces, stained to match.
2. Drawer Sides and Backs: Solid-hardwood lumber, stained to match species indicated for exposed surfaces.
3. Drawer Bottoms: Hardwood plywood.

2.8 PLASTIC-LAMINATE CASEWORK

A. Grade: Custom.

B. AWI Type of Casework Construction: Flush overlay.

C. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:

1. Horizontal Surfaces Other Than Tops: Grade HGS.
2. Postformed Surfaces: Grade HGP.
3. Vertical Surfaces: Grade HGS.
4. Edges: Grade HGS.

D. Materials for Semiexposed Surfaces:

1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, Grade VGS.

   a. Edges of Plastic-Laminate Shelves: PVC tape, 0.018-inch minimum thickness, matching laminate in color, pattern, and finish.
   b. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, Grade VGS.

2. Drawer Sides and Backs: Solid-hardwood lumber.
3. Drawer Bottoms: Hardwood plywood.

E. Concealed Backs of Panels with Exposed Plastic Laminate Surfaces: High-pressure decorative laminate, Grade BKL.

2.9 PLASTIC-LAMINATE COUNTERTOPS

A. Grade: Custom.

B. High-Pressure Decorative Laminate Grade: HGS.

C. Edge Treatment: As indicated.

D. Core Material: Exterior-grade plywood.

E. Backer Sheet: Provide plastic-laminate backer sheet, Grade BKL, on underside of countertop substrate.

2.10 SOLID-SURFACING-MATERIAL COUNTERTOPS

A. Grade: Custom.

B. Solid-Surfacing Material: Recycled plastic.

C. Solid-Surfacing-Material Thickness: 1/2 inch minimum.

D. Fabricate tops in one piece, unless otherwise indicated. Comply with solid-surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.

1. Fabricate tops with shop-applied edges of materials and configuration indicated.
2. Fabricate tops with loose backsplashes for field application.

E. Drill holes in countertops for plumbing fittings and soap dispensers in shop.

2.11 CLOSET AND UTILITY SHELVING

A. Grade: Custom.

B. Shelf Material: 1-inch plastic laminate-faced panel product with solid-lumber edge.

C. Cleats: 3/4-inch solid lumber.

D. Standards for Adjustable Shelf Brackets: BHMA A156.9, B04102; powder-coat-finished steel.

E. Adjustable Shelf Brackets: BHMA A156.9, B04112; powder-coat-finished steel.

F. Clothes Rods: 1-5/16-inch-diameter, chrome-plated-steel tubes.

1. Rod Flanges: Chrome-plated steel.

2.12 SHOP FINISHING

A. General: Comply with AWI/AWMAC/WI's "Architectural Woodwork Standards" for factory finishing.

1. Finish architectural woodwork at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.

B. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural woodwork, as applicable to each unit of work.

1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to back of paneling and to end-grain surfaces. Concealed surfaces of plastic-laminate-clad woodwork do not require

backpriming when surfaced with plastic laminate, backing paper, or thermoset decorative panels.

C. Transparent Finish: Comply with requirements indicated below for grade, finish system, staining, and sheen with sheen measured on 60-degree gloss meter per ASTM D 523:

1. Grade: Same as item to be finished.
2. AWS Finish System 5: Conversion varnish.
3. Staining: Match approved sample for color.
4. Wash Coat for Stained Finish: Apply wash-coat sealer to woodwork made from closed-grain wood before staining and finishing.
5. Open Finish for Open-Grain Woods: Do not apply filler to open-grain woods.
6. Sheen: Satin, 30-50 gloss units.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas.

B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

A. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.

B. Assemble woodwork and complete fabrication at Project site to comply with requirements for fabrication in Part 2, to extent that it was not completed in the shop.

C. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches.

D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Fire-Retardant-Treated Wood: Handle, store, and install fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions, including those for adhesives used to install woodwork.

F. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.

G. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible. Do not use pieces less than 60 inches long, except where shorter single-length pieces are necessary. Scarf running joints and stagger in adjacent and related members.

1. Fill gaps, if any, between top of base and wall with plastic wood filler, sand smooth, and finish same as wood base if finished.
2. Install wall railings on indicated metal brackets securely fastened to wall framing.
3. Install standing and running trim with no more variation from a straight line than 1/8 inch in 96 inches.

H. Casework: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.

1. Install casework with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
2. Maintain veneer sequence matching of casework with transparent finish.

I. Countertops: Anchor securely by screwing through corner blocks of base casework or other supports into underside of countertop.

1. Align adjacent solid-surfacing-material countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
2. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
3. Secure backsplashes to tops with concealed metal brackets at 16 inches and to walls with adhesive.
4. Calk space between backsplash and wall with sealant specified in Section 07 92 00 - JOINT SEALANTS.

J. Touch up finishing work specified in this Section after installation of woodwork. Fill nail holes with matching filler where exposed.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean woodwork on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 06 40 20

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Interior glass-fiber reinforced polyester (GFRP) ceiling dome (FG-1).
2. Exterior glass-fiber reinforced polyester (GFRP) column capitals.

B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 061000 - ROUGH CARPENTRY for wood furring for installing GFRP units.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design dome, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show layout, spacings, sizes, thicknesses of GFRP fabrications; fabrication; and fastening and anchorage details, including mechanical fasteners.

C. Delegated-Design Submittal: For dome indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

D. Samples for Verification: For fabrications and trim accessories, in manufacturer's standard sizes.

1.5 QUALITY ASSURANCE

A. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a qualified professional engineer.

B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of GFRP domes that are similar to those indicated for this Project in material, design, and extent.

C. Manufacturer's Qualifications: Patterns and mockups shall be hand carved and/or CNC machined by skilled pattern makers with minimum of ten (10) years experience with architectural elements. Patterns & mockups shall be available at manufacturing facility for architect's inspection and approval before molds are produced.

1. Custom Molds: Molds shall be produced with ample layers of tooling resin, tooling gel-coat, glass fibers and/or flexible rubber by skilled mold makers with minimum of ten (10) years experience with architectural elements. Produced molds shall have rigidity and thickness to prevent distortion and deflection of molded architectural fiberglass.

D. Source Limitations: Obtain GFRP and trim accessories from single manufacturer.

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install GFRP units until spaces are enclosed and weathertight and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 PLASTIC CORNICE FABRICATIONS

A. Manufacturers: Subject to compliance with requirements, fiberglass manufacturer offering products that may be incorporated in work include:

1. Architectural Fiberglass, Inc.
2. EDON Corporation.
3. Duro Fiber.

2.2 MATERIALS

A. General: The fiberglass reinforced polyester plastic components shall be designed, fabricated and erected to conform to the Building Code, Local Codes and to the Architect's design criteria.

B. Substrate:

1. Resin: Polyester resin shall be fire retardant, and meet Class 1 flame spread rating of 25 or less and smoke density under 450 without the use of antimony trioxide as characterized by the ASTM E-84 tunnel test at typical 1/8" glass mat laminate. General Purpose resin will not be permitted.
2. Filler: Functional filler to be added to resin matrix to minimize shrinkage, add stiffness, control opacity, add fire retardance, improve surface finish, minimize crazing, and control dimensional stability from weather extremes.
3. Fiberglass Reinforcement: Type "E" fiberglass, glass cloth, matt and/or random chopped glass fibers. Glass content approximately 20% to 30%.
4. Laminate Thickness: Nominal laminate shall be minimum 3/16" thickness. Additional core reinforcements and/or sandwich structure added as required for rigidity and structural integrity.

C. Gel Coat:

1. Molded Exterior Surface: U-V inhibited, NPG-ISO polyester gel coat, 18 to 22 mils thick. Color to match in texture and finish of sample supplied by Architect.
2. Barrier Coat: Specifically formulated backup polyester surface veil 18-20 mils thick to prevent glass print through and ultimate Class A finish.

D. Fiberglass-reinforced polyester components shall be manufactured using the specified resins, reinforced with chopped glass fibers. Exposed surfaces shall be finished with custom colored gel-coat.

E. Internal metal reinforcement, anchorage clips, brackets and other “built-in” accessories shall be captured and additionally reinforced with additional glass fiber and matt of sufficient thickness as required by the manufacturer’s design.

F. Metal hardware, both loose and embedded, shall be stainless steel.

G. Gel coat thickness shall be 0.015” minimum to 0.025” maximum.

H. Dome thickness shall be 3/16” minimum for single panel fabrication, 7/16” for sandwich core.

I. Adhesive: As recommended by GFRP unit manufacturer.

J. Sealant: Single-component, mildew-resistant, neutral-curing silicone sealant recommended by GFRP unit manufacturer and complying with requirements in Section 079200 - JOINT SEALANTS.

2.3 FABRICATION

A. Prior to commencement of work review the job site before selective demolition begins to determine the layout, spacing and termination of the existing cornice. Duplicate these layouts intersections and relationships in so far as practical. Identify and resolve GFRP unit detail conflicts in advance and identify such condition and resolutions on the shop drawings.

B. Carefully measure each existing cornice assembly component and replicate size, profile, position, and detail in the finished GFRP unit so far as practical. Indicate on shop drawings those indentations and/or detail which cannot be duplicated in the replication due to physical limitations of the manufacturing process.

C. Full-size models and mock-ups shall be hand carved and machined as required to produce the replication patterns.

D. Production molds shall be constructed from successive layers of glass fiber with tooling gel coat or alternately from rubber molds. Molds shall be constructed with sufficient thickness and rigidity to prevent deflection, warp age and defects during GFRP unit production.

E. Form panels with bolt flanges. Use flanges with sufficient depth to accommodate support, mating and alignment of panel surfaces and panel-to-panel sealant components.

F. Provide all components necessary for a complete, visually continuous, weather tight installation.

G. GFRP units shall be factory fitted and predrilled for later field assembly. GFRP unit sections shall be labeled and numbered for reassembly.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Coordinate required blocking for attachment of GFRP units to substructure. Provide additional wood or metal stud framing as may be required to attached and reinforce GFRP unit for a solid installation.

3.3 INSTALLATION

A. Erect GFRP unit plumb, square and true to line and level. Follow GFRP unit manufacturer's recommendations with regard to installation clearances, notches, and formation of panel-to-panel joints.

B. Install sealant and accessories as work progresses, so as to make the work weather tight.

C. Fill joints with a continuous bead of sealant. Tooling finished joints to a slightly concave profile ensuring complete filing and flush installation.

D. Carefully monitor ambient temperatures at time of GFRP unit installation and observe GFRP unit clearances recommended by the fiberglass manufacturer.

E. Do not cut or abrade finishes, which cannot be completely restored in the field. Installer to make small inconspicuous finish repairs using manufactures color matching gel fill finish. If to large of a repair is needed return to fiberglass manufacturer for alterations or new units.

F. Use only stainless steel connectors approved by the GFRP unit manufacturer and which will develop the strength required by GFRP unit manufacturer's calculations. The installer shall supply these connectors.

G. Countersink exposed fasteners. Patch attachment holes with gel fill finish supplied by the manufacturer for field application. Finish attachment points so that there is no detectable difference in the completed dome surface.

H. Clean installed GFRP unit to remove dirt, smudges, and construction dirt. Use only those cleaning products and procedures recommended by the fiberglass manufacturer.

I. Finish at Interior Units: Provide Level 5 finish as specified in Section 092110 - GYPSUM BOARD ASSEMBLIES.

END OF SECTION 066500

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Waterproofing at below grade concrete roofs and foundation walls at Knuckle Mechanical Room and tunnel connecting Jennings building:
   a. Rubberized-asphalt waterproofing membrane, reinforced.
   b. Molded-sheet drainage panels.
2. Coordination of unit paver installation with Section 32 14 00 - UNIT PAVING.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 07 21 00 - THERMAL INSULATION for insulation at foundations and under slabs.
2. Section 07 92 00 - JOINT SEALANTS for joint-sealant materials and installation.
3. Section 07 95 00 - EXPANSION CONTROL for expansion-joint systems.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include manufacturer's written instructions for evaluating, preparing, and treating substrate, technical data, and tested physical and performance properties of waterproofing.

B. Shop Drawings: Show locations and extent of waterproofing. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins to adjoining waterproofing, and other termination conditions.

C. Samples: For the following products:

1. 12-by-12-inch square of waterproofing and flashing sheet.
2. 4-by-4-inch square of drainage panel.

D. Installer Certificates: Signed by manufacturers certifying that installers comply with requirements.

E. Sample Warranty: Copy of special waterproofing manufacturer's and Installer's warranty stating obligations, remedies, limitations, and exclusions before starting waterproofing.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who is acceptable to waterproofing manufacturer to install manufacturer's products.

B. Source Limitations: Obtain waterproofing materials, protection course, and molded-sheet drainage panels through one source from a single manufacturer.

C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01. Review requirements for waterproofing, including surface preparation specified under other Sections, substrate condition and pretreatment, minimum curing period, forecasted weather conditions, special details and sheet flashings, installation procedures, testing and inspection procedures, and protection and repairs.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver liquid materials to Project site in original packages with seals unbroken, labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by waterproofing manufacturer.

C. Remove and replace liquid materials that cannot be applied within their stated shelf life.

D. Protect stored materials from direct sunlight.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate, or when temperature is below 0 deg F.

1. Do not apply waterproofing in snow, rain, fog, or mist.

B. Maintain adequate ventilation during application and curing of waterproofing materials.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace waterproofing and sheet flashings that do not comply with requirements or that fail to remain watertight within specified warranty period.

1. Warranty insulation will retain 80 percent of original published thermal value.
2. Warranty Period: Twenty years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1. Hot Fluid-Applied, Rubberized-Asphalt Waterproofing Membrane:

a. American Hydrotech, Inc.; Monolithic Membrane 6125.
b. Carlisle Coatings & Waterproofing Inc.; CCW-500R.
c. Henry Company; 790-11.
d. Tremco Incorporated; Tremproof 150.

2. Basis-of-Design: American Hydrotech, Inc.; Monolithic Membrane 6125

2.2 WATERPROOFING MEMBRANE

A. Hot Fluid-Applied, Rubberized-Asphalt Waterproofing Membrane: Single component; 100 percent solids; hot fluid-applied, rubberized asphalt.

B. Physical Properties:

PROPERTY	TEST METHOD	TYPICAL RESULTS
Flash Point	ASTM D-92, CGSB-37.50-M89	500°F*
Low Temperature Crack Bridging Capability	CGSB-37.50-M89	No cracking, adhesion loss, or splitting
Water Vapor Permeability	ASTM E 96, Procedure E, CGSB-37.50-M89	1.6ng/Pa(s)M², (0.018 perm)
Water Resistance (5 days/50 °C)	CGSB-37.50-M89	No delamination, blistering, emulsification, or deterioration
Water Absorption	CGSB-37.50-M89	0.22g weight gain
Toughness	CGSB-37.50-M89	13.0 Joules
Ratio of Toughness to Peak Load	CGSB-37.50-M89	0.069
Viscosity	CGSB-37.50-M89	7.0 seconds
Heat Stability	CGSB-37.50-M89	No change in viscosity, penetration, flow or low temperature flexibility
Low Temperature Flexibility (- 25 °C)	CGSB-37.50-M89	No delamination, flexibility adhesion loss, or cracking
Penetration	ASTM D 1191, CGSB-37.50-M89	75.0 mm at 77°F, 121.7mm at 122 °F
Flow	ASTM D 1191, GSB-37.50-M89	0.0mm @ 140°F
Softening Point	ASTM D 36	180°F
Elongation	ASTM D 1191	1000% minimum
Resiliency	ASTM D 3407	40% minimum
Bond to Concrete @ 0 °F, (18 °C)	ASTM D 3408	Pass
Hydrostatic Pressure Resistance	ASTM D-08.22, Draft 2	100 psi (=231 foot head of water)
Acid Resistance	ASTM D 896 Procedure 7.1(N-8)	Pass 50% Nitric Acid, 50% Sulfuric Acid
Salt Water Resistance (20% sodium carbonate and cal-	ASTM D-896 similar	No delamination, blistering, emulsification, or deterioration

cium chloride)
*45°F more than the application temperature recommended by the manufacturer.

2.3 FLASHING SHEET MATERIALS

A. Elastomeric Flashing Sheet: 50-mil-minimum, uncured sheet neoprene as follows:

1. Tensile Strength: 1400 psi minimum; ASTM D 412, Die C.
2. Elongation: 300 percent minimum; ASTM D 412.
3. Tear Resistance: 125 psi minimum; ASTM D 624, Die C.
4. Brittleness: Does not break at minus 30 deg F; ASTM D 2137.

2.4 AUXILIARY MATERIALS

A. Primer: ASTM D 41, asphaltic primer.

B. Elastomeric Sheet: 50-mil-minimum, uncured sheet neoprene as follows:

1. Tensile Strength: 1400 psi minimum; ASTM D 412, Die C.
2. Elongation: 300 percent minimum; ASTM D 412.
3. Tear Resistance: 125 psi minimum; ASTM D 624, Die C.
4. Brittleness: Does not break at minus 30 deg F; ASTM D 2137.

C. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum termination bars; approximately 1 by 1/8 inch thick; with anchors.

D. Sealants and Accessories: Manufacturer's recommended sealants and accessories.

E. Reinforcing Fabric: Manufacturer's recommended, spun-bonded polyester fabric equal to “Flex-Flash Reinforcement” by American Hydrotech, complying with the following:

1. Unit Weight: 1.35 oz./sq.yd. per ASTM D 1910.

2.5 MOLDED-SHEET DRAINAGE PANELS

A. Nonwoven-Geotextile-Faced, Molded-Sheet Drainage Panel: Manufactured composite subsurface drainage panels consisting of a nonwoven, needle-punched geotextile facing with an apparent opening size not exceeding No. 70 (0.21-mm) sieve laminated to 1 side and a polymeric film bonded to the other side of a 3-dimensional, nonbiodegradable, molded-plastic-sheet drainage core, with a vertical flow rate of 9 to 15 gpm per ft.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify that concrete has cured and aged for minimum time period recommended by waterproofing manufacturer.

2. Verify that substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean and prepare substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for waterproofing application.

B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.

C. Close off deck drains and other deck penetrations to prevent spillage and migration of waterproofing fluids.

D. Remove grease, oil, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

E. Remove fins, ridges, and other projections and fill honeycomb, aggregate pockets, and other voids.

3.3 JOINTS, CRACKS, AND TERMINATIONS

A. Prepare and treat substrates to receive waterproofing membrane, including joints and cracks, deck drains, corners, and penetrations according to manufacturer's written instructions.

1. Rout and fill joints and cracks in substrate. Before filling, remove dust and dirt according to ASTM D 4258.
2. Adhere strip of elastomeric sheet to substrate in a layer of hot rubberized asphalt. Extend elastomeric sheet a minimum of 6 inches on each side of moving joints and cracks or joints and cracks exceeding 1/8 inch thick, and beyond deck drains and penetrations. Apply second layer of hot fluid-applied, rubberized asphalt over elastomeric sheet.
3. Embed strip of reinforcing fabric into a layer of hot rubberized asphalt. Extend reinforcing fabric a minimum of 6 inches on each side of nonmoving joints and cracks not exceeding 1/8 inch thick, and beyond roof drains and penetrations.
   a. Apply second layer of hot fluid-applied, rubberized asphalt over reinforcing fabric.

3.4 FLASHING INSTALLATION

A. Install elastomeric flashing sheets at terminations of waterproofing membrane according to manufacturer's written instructions.

B. Prime substrate with asphalt primer.

C. Install elastomeric flashing sheet and adhere to deck and wall substrates in a layer of hot rubberized asphalt.

D. Extend elastomeric flashing sheet up walls or parapets a minimum of 8 inches (200 mm) above plaza deck pavers and 6 inches (150 mm) onto deck to be waterproofed.

E. Install termination bars and mechanically fasten to top of elastomeric flashing sheet at terminations and perimeter of roofing.

3.5 MEMBRANE APPLICATION

A. Apply primer, at manufacturer's recommended rate, over prepared substrate and allow to dry.

B. Heat and apply rubberized asphalt according to manufacturer's written instructions.

1. Heat rubberized asphalt in an oil- or air-jacketed melter with mechanical agitator specifically designed for heating rubberized asphalt.

C. Start application with manufacturer's authorized representative present.

D. Reinforced Membrane: Apply hot rubberized asphalt to substrates and adjoining surfaces indicated. Spread to a thickness of 90 mils (2.3 mm); embed reinforcing fabric, overlapping sheets 2 inches (50 mm); spread another 125-mil- (3.2-mm-) thick layer to provide a uniform, reinforced, seamless membrane 215 mils (5.5 mm) thick.

E. Apply waterproofing over prepared joints and up wall terminations and vertical surfaces to heights indicated or required by manufacturer.

3.6 MOLDED-SHEET DRAINAGE PANEL INSTALLATION

A. Place and secure molded-sheet drainage panels, with geotextile facing away from wall or deck substrate according to manufacturer's written instructions. Use methods that do not penetrate waterproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.

3.7 FIELD QUALITY CONTROL

A. Flood Testing: Flood test each deck area for leaks, according to recommendations in ASTM D 5957, after completing waterproofing but before overlying construction is placed. Install temporary containment assemblies, plug or dam drains, and flood with potable water.

1. Flood to an average depth of 2-1/2 inches with a minimum depth of 1 inch and not exceeding a depth of 4 inches. Maintain 2 inches of clearance from top of sheet flashings.
2. Flood each area for 24 hours.
3. After flood testing, repair leaks, repeat flood tests, and make further repairs until waterproofing installation is watertight.

B. Engage an independent testing agency to observe flood testing and examine underside of decks and terminations for evidence of leaks during flood testing.

3.8 CLEANING AND PROTECTION

A. Protect waterproofing from damage and wear during remainder of construction period.

B. Protect installed insulation drainage panels from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation

will be subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

C. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Latex-rubber waterproofing membrane at the building's north and south wings and Knuckle south facing foundation walls.
2. Drainage board.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 07 21 00 - THERMAL INSULATION for insulation/drainage board at foundations.
2. Section 07 92 00 - JOINT SEALANTS for joint-sealant materials and installation.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include manufacturer's written instructions for evaluating, preparing, and treating substrate, technical data, and tested physical and performance properties of waterproofing.

B. Samples: For the following products:

1. 12-by-12-inch square of waterproofing and reinforcing strip.
2. 12-by-12-inch square of drainage board.

C. Installer Certificates: Signed by manufacturers certifying that installers comply with requirements.

D. Sample Warranty: Copy of special waterproofing manufacturer's and Installer's warranty stating obligations, remedies, limitations, and exclusions before starting waterproofing.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who is acceptable to waterproofing manufacturer to install manufacturer's products and with a minimum of 3 years experience in work similar in size and scope.

B. Source Limitations: Obtain waterproofing materials, protection course, and molded-sheet drainage panels through one source from a single manufacturer.

C. Compatibility: Confirm that materials provide in this Section are compatible with membrane and materials specified in Section 072700 - AIR BARRIERS.

D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01. Review requirements for waterproofing, including surface preparation specified under other Sections, substrate condition and pretreatment, minimum curing period, forecasted weather conditions, special details and sheet flashings, installation procedures, testing and inspection procedures, and protection and repairs.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver liquid materials to Project site in original packages with seals unbroken, labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by waterproofing manufacturer.

C. Remove and replace liquid materials that cannot be applied within their stated shelf life.

D. Protect stored materials from direct sunlight.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate, or when temperature is below 0 deg F.

1. Do not apply waterproofing in snow, rain, fog, or mist.

B. Maintain adequate ventilation during application and curing of waterproofing materials.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace waterproofing and sheet flashings that do not comply with requirements or that fail to remain watertight within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

B. Special Installer's Warranty: Signed by Installer, covering Work of this Section, for warranty period of two years.

1. Warranty includes removing and reinstalling insulation/drainage board.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Provide products by one of the following:

1. W. R. Grace & Co.
2. Carlisle Coatings & Waterproofing Inc.
3. Henry Company.
4. Tremco Incorporated.

2.2 LATEX-RUBBER WATERPROOFING

A. Two-Component, Unreinforced, Latex-Rubber Waterproofing: Comply with ASTM C 836 and with manufacturer's written physical requirements.

1. Products: Subject to compliance with requirements, provide the following:

a. Grace, W. R. & Co.; Procor.

2.3 AUXILIARY MATERIALS

A. General: Provide auxiliary materials recommended by manufacturer to be compatible with one another and with waterproofing, as demonstrated by waterproofing manufacturer, based on testing and field experience.

B. Joint Reinforcing Strip: Manufacturer's recommended fiberglass mesh or polyester fabric.

C. Joint Sealant: Multicomponent polyurethane sealant, compatible with waterproofing, complying with ASTM C 920 Type M, Class 25; Grade NS for sloping and vertical applications or Grade P for deck applications; Use NT exposure; and as recommended by manufacturer for substrate and joint conditions.

1. Backer Rod: Closed-cell polyethylene foam.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify that concrete has cured and aged for minimum time period recommended by waterproofing manufacturer.
2. Verify that substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
3. Verify that joints at concrete masonry units are struck flush.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean and prepare substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for waterproofing application.

B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.

C. Close off deck drains and other deck penetrations to prevent spillage and migration of waterproofing fluids.

D. Remove grease, oil, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

E. Remove fins, ridges, and other projections and fill honeycomb, aggregate pockets, and other voids. Remove scaling to sound unaffected concrete and repair exposed areas.

F. Grind irregular construction joint to provide a suitable flush surface.

3.3 JOINTS, CRACKS, AND TERMINATIONS

A. Prepare and treat substrates to receive waterproofing membrane, including joints and cracks, deck drains, corners, and penetrations according to manufacturer's written instructions.

1. Rout and fill joints and cracks in substrate. Before filling, remove dust and dirt according to ASTM D 4258.
2. Adhere strip of elastomeric sheet to substrate in a layer of hot rubberized asphalt. Extend elastomeric sheet a minimum of 6 inches on each side of moving joints and cracks or joints and cracks exceeding 1/8 inch thick, and beyond deck drains and penetrations. Apply second layer of hot fluid-applied, rubberized asphalt over elastomeric sheet.
3. Embed strip of reinforcing fabric into a layer of hot rubberized asphalt. Extend reinforcing fabric a minimum of 6 inches on each side of nonmoving joints and cracks not exceeding 1/8 inch thick, and beyond roof drains and penetrations.

    a. Apply second layer of hot fluid-applied, rubberized asphalt over reinforcing fabric.

3.4 MEMBRANE APPLICATION

A. Apply waterproofing according to ASTM C 898 and manufacturer's written instructions.

B. Start installing waterproofing in presence of manufacturer's technical representative.

C. Apply primer over prepared substrate.

D. Unreinforced Waterproofing Applications: Mix materials and apply waterproofing by spray, roller, notched squeegee, trowel, or other application method suitable to slope of substrate.

1. Apply one or more coats of waterproofing to obtain a seamless membrane free of entrapped gases, with an average dry film thickness of 60 mils and a minimum dry film thickness of 50 mils at any point.
2. Apply waterproofing to prepared wall terminations and vertical surfaces.
3. Verify wet film thickness of waterproofing every 100 sq. ft.

3.5 CLEANING AND PROTECTION

A. Protect waterproofing from damage and wear during remainder of construction period.

B. Protect installed waterproofing from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation will be subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

C. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Negative side, modified cement waterproofing for the following applications:
   a. Elevator pits.
   b. Sump pits.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 03 30 00 - CAST-IN-PLACE CONCRETE for concrete substrate and finishing concrete walls and slabs to receive waterproofing.
2. Section 07 92 00 - JOINT SEALANTS for elastomeric and preformed sealants in concrete and masonry walls and floors.

1.3 SUBMITTALS

A. Product Data: Include construction details, and material descriptions and installation instructions for modified cement waterproofing.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1.5 PROJECT CONDITIONS

A. Weather Limitations: Proceed with application only when existing and forecasted weather conditions permit modified cement waterproofing to be performed according to manufacturer's written instructions and warranty requirements.

B. Proceed with waterproofing work only after pipe sleeves, vents, curbs, inserts, drains, and other projections through the substrate to be waterproofed have been completed. Proceed only after concrete and masonry substrate defects, including honeycombs, voids, and cracks, have been repaired to provide a sound substrate free of forming materials, including reveal inserts.

C. Ambient Conditions: Proceed with waterproofing work only if temperature is maintained at 40 deg F or above during work and cure period, and space is well ventilated and kept free of water.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of modified cement waterproofing that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure to maintain watertight conditions within specified warranty period.
b. Bond failure.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1. Negative-Side, Prepackaged, Modified Cement Waterproofing:

a. AQUAFIN, Inc.; Aquafin-1K.
b. BASF Building Systems; Sonnoblock.
c. Conproco Corp.; Conpro Seal with K-88.
d. Five Star Products, Inc.; Five Star Cement Coat.
e. Sika Corporation Inc.; Sika Top Seal 107.

2.2 MATERIALS

A. Prepackaged, Modified Cement Waterproofing: Manufacturer's proprietary blend of dry cementitious and other ingredients for mixing with water to produce a waterproof coating that is suitable for vertical and horizontal applications below or above grade, is breathable, and resists negative hydrostatic pressure, has VOC content complying with limits of authorities having jurisdiction, and has properties meeting or exceeding the criteria specified below.

1. Properties of Cured Waterproofing:

a. Permeability: 0 for water at 30 feet when tested according to CE CRD-C 48.
b. Compressive Strength: Minimum 3600 psi at 28 days when tested according to ASTM C 109/C 109M.
c. Flexural Strength: Minimum 725 psi at 28 days when tested according to ASTM C 348.

d. Bond Strength: 300 psi at 14 days when tested according to ASTM C 321.

2.3 ACCESSORY MATERIALS

A. Patching Compound: Factory-premixed cementitious repair mortar, crack filler, or sealant recommended by waterproofing manufacturer for filling and patching tie holes, honeycombs, reveals, and other imperfections; compatible with substrate and other materials indicated; and VOC content complying with limits of authorities having jurisdiction.

B. Portland Cement: ASTM C 150, Type I.

C. Trowel-Coat Sand: ASTM C 33, fine aggregate.

D. Polymer Admixture for Protective Topping: Polymer bonding agent and admixture designed to improve adhesion to prepared substrates and to not create a vapor barrier.

E. Water: Potable.

2.4 PROPORTION AND DESIGN OF MIXES

A. Prepackaged, Modified Cement Waterproofing:

1. Add prepackaged dry ingredients to mixing liquid according to manufacturer's written instructions. Mix together with mechanical mixer or by hand to required consistency.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Acceptance of Conditions: Examine substrates, with Applicator present, where waterproofing is to be applied.

1. Proceed with application only after unsatisfactory conditions have been corrected.
2. Notify Architect in writing of active leaks or structural defects that would affect system performance.

3.2 PREPARATION

A. Protect other work from damage from cleaning, preparation, and application of modified cement waterproofing. Provide temporary enclosure to confine spraying operation, and to ensure adequate ambient temperatures and ventilation conditions for application.

B. Stop active water leaks according to waterproofing manufacturer's written instructions.

C. Repair damaged or unsatisfactory concrete or masonry according to manufacturer's written instructions.

D. Surface Preparation: Comply with waterproofing manufacturer's written instructions to remove efflorescence, chalk, dust, dirt, mortar spatter, grease, oils, paint, curing compounds, and form-release agents to ensure that waterproofing bonds to concrete or masonry surfaces.

1. Clean concrete surfaces according to ASTM D 4258.

   a. Scratch- and Float-Finished Concrete: Etch with 10 percent muriatic (hydrochloric) acid solution according to ASTM D 4260.

2. Concrete Joints: Clean reveals according to waterproofing manufacturer's written instructions.

3.3 APPLICATION

A. General: Comply with waterproofing manufacturer's written instructions for application.

1. Dampen surface with water and maintain damp condition until applying waterproofing.
2. Apply waterproofing to negative side surfaces. Apply first bond coat as a slurry with brush or stiff broom, and subsequent coats with brush, spray, or trowel to specified surface finish. Dampen surface between coats.
3. Total Thickness: Two 1/16 inch coats, total 1/8 inch total thickness.

B. Final Coat Finish: Smooth troweled.

C. Curing: Air-cure waterproofing.

D. Waterproofing Treatment Extensions: Extend waterproofing treatment as follows:

1. Onto columns integral with treated walls.
2. Onto every substrate in areas indicated for treatment, including pipe trenches, pits and sumps.

3.4 PROTECTION

A. Protect applied, modified cement waterproofing from rapid drying, severe weather exposure, and water accumulation. Maintain completed Work in moist condition for not less than seven days by covering with impervious sheeting or by other curing procedures recommended in writing by waterproofing manufacturer.

3.5 FIELD QUALITY CONTROL

A. Inspection: Engage manufacturer's representative to inspect completed application and to provide a written report that application complies with manufacturer's written instructions.

END OF SECTION 07 16 00

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Insulation under slabs-on-grade.
2. Perimeter foundation wall insulation/drainage board.
3. Cavity wall insulation.
4. Spray polyurethane foam insulation.
5. Thermal barrier over foam plastic insulation at attic and crawl spaces.
6. Thermal barrier over foam plastic insulation at occupied spaces.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 07 27 00 - AIR BARRIERS for air and vapor barrier membrane.
2. Section 07 54 00 - THERMOPLASTIC MEMBRANE ROOFING for roofing insulation.
3. Section 09 21 10 - GYPSUM BOARD ASSEMBLIES for acoustic insulation in gypsum board assemblies.
4. Division 22 - PLUMBING for plumbing insulation.
5. Division 23 - HEATING, VENTILATING, AND AIR CONDITIONING for mechanical insulation.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material.

Include statement indicating cost for each regional material and the fraction by weight that is considered regional.

3. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.

C. Qualification Data: For Installer of spray-applied products.

D. Thermal and Ignition Barriers: Submit active building code evaluation report that lists report number and effective dates of product acceptance.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of building insulation through one source from a single manufacturer.

B. Installer Qualifications: A qualified installer who has been trained by and is acceptable to spray polyurethane foam insulation manufacturer to install manufacturer's products.

C. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

D. FMG Requirements: Insulation shall comply with the requirements of FM Global.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. Protect plastic and spray polyurethane foam insulation as follows:

1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver plastic insulating materials to Project site before installation time.
3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 FOUNDATION UNDER SLAB INSULATION AND ABOVE CERAMIC TILES AT EXTERIOR SOFFITS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. DiversiFoam Products.
2. Dow Chemical Company.
3. Owens Corning.

B. Board Insulation: Extruded-polystyrene board insulation complying with ASTM C 578, square edged of type, density, and compressive strength indicated below:

1. For vertical applications, Type IV, 1.6-lb/cu. ft. minimum density and 25-psi minimum compressive strength.
2. For horizontal applications, pedestrian traffic, Type VII, 2.2-lb/cu. ft. minimum density and 60-psi minimum compressive strength.
3. For horizontal applications, vehicular traffic, Type V, 3-lb/cu. ft. minimum density and 100-psi minimum compressive strength.
4. For horizontal applications at exterior soffits, Type IV, 1.6-lb/cu. ft. minimum density and 25-psi minimum compressive strength.
5. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 20 percent.

C. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation and substrates.

2.2 FOUNDATION WALL INSULATION/DRAINAGE BOARD

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Roxul Inc.
2. Fibrex Insulation Inc.
3. Owens Corning.
4. Thermafiber.

B. Basis-of-Design: Roxul DrainBoard R-10 by Roxul.

C. Unfaced, Mineral-Wool Fiber Insulation: Maximum flame-spread and smoke-developed indexes of 0 and >5, respectively, per ASTM E 84.

1. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
2. R-Value: 4.3 per inch per ASTM C 518.
3. Density: 8 lbs/ft^3.
4. Moisture Resistance: >1.5^o at 10% deformation per ASTM C 165, 355 lbs/ft^2.

D. Fasteners: As recommended by manufacturer.

2.3 CAVITY WALL INSULATION

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Roxul Inc.
2. Fibrex Insulation Inc.
3. Owens Corning.
4. Thermafiber.

B. Basis-of-Design: CavityRock DD (Dual Density) by Roxul.

C. Unfaced, Mineral-Wool Board Insulation: ASTM C 612; with maximum flame-spread and smoke-developed indexes of 15 and zero, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

1. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 75 percent.
2. R-Value: 4.3 per inch.

D. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation and substrates.

2.4 SPRAY POLYURETHANE FOAM INSULATION

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1. BASF Corporation; WALLTITE.
2. CertainTeed Corporation; Certaspray.
3. Corbond Corporation, a division of Johns Manville; Corbond III.
4. Dow Chemical Company; STYROFOAM Spray Polyurethane Foam (CM Series).
5. NCFI, a Division of Barnhardt Mfg. Co.; InsulStar.

B. Closed-Cell Polyurethane Foam Insulation: ASTM C 1029, Type II, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.

1. Minimum density of 1.5 lb/cu. ft., thermal resistivity of 6.2 deg F x h x sq. ft./Btu x in. at 75 deg F.

2.5 SPRAYED-FOAM INSULATION AT GAPS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1. Canam Building Envelope Specialists; Zerodraft Z1-24 Foam Sealant.
2. Dow Chemical; GreatStuff Pro.
3. Foam-Tech Div. of H.C. Fennell; SuperGreen Foam.
4. Todol Products; Pur Fill 1G.

B. Sprayed-Foam Insulation: Water-cure closed cell polyurethane containing no urea-formaldehyde and no CFCs.

1. Minimum density of 0.4 lb/cu. ft., thermal resistivity of 3.4 deg F x h x sq. ft./Btu x in. at 75 deg F.

2.6 THERMAL AND IGNITION BARRIERS

A. Thermal Barrier for Foam Plastic Insulation at Occupied Spaces: Provide thermal barrier recommended by foam plastic manufacturer and tested with the specific product. Product shall have an active building code evaluation report that lists report number and effective dates of product acceptance.

B. Thermal Barrier for Foam Plastic Insulation at Attic and Crawl Spaces: Provide thermal barrier recommended by foam plastic manufacturer and tested with the specific product. Product shall have an active building code evaluation report that lists report number and effective dates of product acceptance.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements of Sections in which substrates and related work are specified and for other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of substances harmful to insulation or vapor retarders, including removing projections capable of puncturing vapor retarders or of interfering with insulation attachment.

3.3 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice, rain, and snow.

C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Spray Polyurethane Foam: Comply with recommendations of the American Chemistry Council, “Health and Safety Product Stewardship Workbook for High-Pressure Application of Spray Polyurethane Foam (SPF).”

1. Closed Cell Spray Polyurethane Foam: Spray insulation no greater than 1-1/2 inch thickness per layer. Allow each layer to fully cure before spraying additional thickness.
2. Contain and fully ventilate the area being sprayed with negative air machines, venting directly to the exterior. Do not operate permanent building HVAC system during installation. Continue ventilation during curing process.
3. Install spray polyurethane foam insulation with uniform full thickness and with density which will not displace adjacent materials.

E. Thermal and Ignition Barriers: Comply with manufacturer’s recommendations and as required to comply with code requirements.

F. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

1. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

3.4 INSTALLATION OF UNDERSLAB INSULATION

A. On horizontal surfaces, loosely lay rigid insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

3.5 INSTALLATION OF FOUNDATION WALL INSULATION/DRAINAGE BOARD

A. Apply insulation/drainage board sheets either horizontally or vertically to the foundation wall, ensuring that sheets are tightly butted together. Joints do not require caulking.

B. Fasten insulation/drainage board sheets using approved nails with washers. Place fasteners 4” from the sides of the sheet, one at each corner.

C. Insulation/drainage board sheets may be cut to fit around penetrations or other irregularities providing that all below grade details, exposed to the soil are caulked along the line where insulation/drainage board material flushes with the foundation.

D. Seal the top of the installation at grade level with a bead of construction grade caulking. This is to prevent soil from becoming trapped behind the sheets during backfill operations.

E. Ensure finished grade is within 3” of the top of the insulation/drainage board sheets.

F. Backfill operations can commence immediately after insulation/drainage board is installed, year round..

3.6 INSTALLATION OF CAVITY-WALL INSULATION

A. On units of mineral wool board insulation, install pads of adhesive spaced approximately 24 inches o.c. both ways on inside face, and as recommended by manufacturer. Fit courses of insulation between wall ties (if applicable) and other obstructions, with edges butted tightly in both directions. Press units firmly against inside substrates indicated. Fill gaps with compatible insulating material.

3.7 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

A. Spray-Applied Insulation: Apply spray-applied insulation according to manufacturer's written instructions. Do not apply insulation until installation of pipes, ducts, conduits, wiring, and electrical outlets in walls is completed and windows, electrical boxes, and other items not indicated to receive insulation are masked. After insulation is applied, make flush with face of studs by using method recommended by insulation manufacturer.

3.8 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 07 21 00

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Fluid-applied, vapor-retarding membrane air barrier at exterior walls and as indicated on the Drawings.
2. Transition strips to adjacent and penetrating materials.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 06 16 00 - SHEATHING for sheathing substrate for air and vapor barrier system.
2. Section 07 54 00 - THERMOPLASTIC MEMBRANE ROOFING for connection to roof air and vapor barrier.

1.3 DEFINITIONS

A. Air Barrier Assembly: The collection of air barrier materials and auxiliary materials applied to an opaque wall or soffit, including joints and junctions to abutting construction, to control air movement through the wall.

1.4 PERFORMANCE REQUIREMENTS

A. General: Air barrier shall be capable of performing as a continuous vapor-retarding air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

B. Air Barrier Assembly Air Leakage: Not to exceed 0.03 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft., ASTM E 283.

1.5 PRECONSTRUCTION TESTING

A. Mockup Testing: Air barrier assemblies shall comply with performance requirements indicated, as evidenced by reports based on mockup testing by a qualified testing agency.

1. The Owner may engage a qualified testing agency.
2. Quantitative Air Leakage Testing: Testing of the mockup for air leakage will be conducted not to exceed the test pressure differential, positive and negative, indicated in "Performance Requirements" Article for air barrier assembly air leakage when tested according to ASTM E 283.
3. Notify Architect and the Owner a minimum of seven days in advance of the dates and times when mockup testing will take place.

1.6 SUBMITTALS

A. Product Data: Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties of air barrier.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.
3. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.

C. Shop Drawings: Show locations and extent of air barrier. Include details for substrate joints and cracks, counterflashing strip, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.

1. Include details of interfaces with other materials that form part of air barrier.
2. Include details of mockups.

D. Product Certificates: For air barriers, certifying compatibility of air barrier and accessory materials with Project materials that connect to or that come in contact with air barrier; signed by product manufacturer.

E. Qualification Data: For Applicator.

F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for air barriers.

1.7 QUALITY ASSURANCE

A. Applicator Qualifications: A firm experienced in applying air barrier materials similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.

B. Mockups: Before beginning installation of air barrier, build mockups of exterior wall assembly 150 sq. ft., incorporating backup wall construction, external cladding, window, door frame and sill, insulation, and flashing to demonstrate surface preparation, crack and joint treatment, and sealing of gaps, terminations, and penetrations of air barrier membrane.

1. Coordinate construction of mockup to permit inspection by Owner's testing agency of air barrier before external insulation and cladding is installed.
2. Include junction with roofing membrane, building corner condition, and foundation wall intersection.
3. If the Architect determines mockups do not comply with requirements, reconstruct mockups and apply air barrier until mockups are approved.
4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

C. Preinstallation Conference: Conduct conference at Project site.

1. Include installers of other construction connecting to air barrier, such as roofing, waterproofing, architectural precast concrete, masonry, joint sealants, windows, glazed curtain walls, and door frames.
2. Review air barrier requirements including surface preparation, substrate condition and pretreatment, minimum substrate curing period, forecasted weather conditions, special details and sheet flashings, mockups, installation procedures, sequence of installation, testing and inspecting procedures, and protection and repairs.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store liquid materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by air barrier manufacturer.

B. Remove and replace liquid materials that cannot be applied within their stated shelf life.

C. Store rolls according to manufacturer's written instructions.

D. Protect stored materials from direct sunlight.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended by air barrier manufacturer. Protect substrates from environmental conditions that affect performance of air barrier. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 FLUID-APPLIED MEMBRANE AIR BARRIER

A. Fluid-Applied, Vapor-Retarding Membrane Air Barrier: Elastomeric, modified bituminous or synthetic polymer membrane.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Elastomeric Modified Bituminous Membrane:

1) Carlisle Coatings & Waterproofing; Barriseal.
2) Henry Company; Air-Bloc 06.
3) Meadows, W. R., Inc.; Air-Shield LM.
4) Tremco Incorporated; ExoAir.

b. Synthetic Polymer Membrane:

1) Grace, W. R. & Co.; Perm-A-Barrier Liquid.
2) Henry Company; Air-Bloc [21 or 21S] [21FR] [32].
3) Rubber Polymer Corporation; Rub-R-Wall Airtight.

2. Physical and Performance Properties:

a. Membrane Air Permeance: Not to exceed 0.004 cfm x sq. ft. of surface area at 1.57-lbf/sq. ft. pressure difference; ASTM E 2178.
b. Membrane Vapor Permeance: Not to exceed 0.1 perm; ASTM E 96.

3. Basis-of-Design: Perm-A-Barrier by Grace.

2.2 AUXILIARY MATERIALS

A. General: Auxiliary materials recommended by air barrier manufacturer for intended use and compatible with air barrier. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.

B. Primer: Liquid waterborne or solvent-borne primer recommended for substrate by manufacturer of air barrier material.

C. Counterflashing Strip: Modified bituminous 40-mil-thick, self-adhering sheet consisting of 32 mils of rubberized asphalt laminated to an 8-mil-thick, crosslaminated polyethylene film with release liner backing.

D. Butyl Strip at Termination with EPDM or TPO Roofing Membrane: Vapor-retarding, 30- to 40-mil-thick, self adhering; polyethylene-film-reinforced top surface laminated to layer of butyl adhesive, with release liner backing.

E. Modified Bituminous Strip To Cover Cracks and Joints and Terminate Air Barrier to Compatible Roofing Membrane: Vapor-retarding, 40-mil-thick, smooth-surfaced, self-adhering; consisting of 36 mils of rubberized asphalt laminated to a 4-mil- polyethylene film with release liner backing.

F. Termination Mastic: Cold fluid-applied elastomeric liquid; trowel grade.

G. Substrate Patching Membrane: Manufacturer's standard trowel-grade substrate filler.

H. Adhesive and Tape: Air barrier manufacturer's standard adhesive and pressure-sensitive adhesive tape.

I. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, 0.0187 inch thick, and Series 300 stainless-steel fasteners.

J. Sprayed Polyurethane Foam Sealant to Fill Gaps at Penetrations and Openings: 1- or 2-component, foamed-in-place, polyurethane foam sealant, 1.5 to 2.0 lb/cu. ft. density; flame spread index of 25 or less according to ASTM E 162; with primer and noncorrosive substrate cleaner recommended by foam sealant manufacturer.

K. Modified Bituminous Transition Strip to Seal Air Barrier Terminations with Glazing Systems: Vapor-retarding, 40-mil-thick, smooth-surfaced, self-adhering; consisting of 36 mils of rubberized asphalt laminated to a 4-mil-thick polyethylene film with release liner backing.

L. Preformed Silicone-Sealant Extrusion to Seal Air Barrier Terminations with Glazing Systems: Manufacturer's standard system consisting of cured low-modulus silicone extrusion, sized to fit opening widths, with a single-component, neutral-curing, Class 100/50 (low-modulus) silicone sealant for bonding extrusions to substrates.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Dow Corning Corporation, 123 Silicone Seal.
b. GE Silicone, UltraSpan US1100.
c. Pecora Corporation, Sil-Span.
d. Tremco, Incorporated, Spectrem EZ Simple Seal.
e. Or approved equal.

M. Joint Sealant: ASTM C 920, single-component, neutral-curing silicone; Class 100/50 (low-modulus), Grade NS, Use NT related to exposure, and, as applicable to joint substrates indicated, Use O. Comply with Section 07 92 00 - JOINT SEALANTS.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance.

1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
2. Verify that concrete has cured and aged for minimum time period recommended by air barrier manufacturer.
3. Verify that concrete is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
4. Verify that masonry joints are flush and completely filled with mortar.
5. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

A. Clean, prepare, and treat substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air barrier application.

B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.

C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching membrane.

E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.

F. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D 4258.

1. Install modified bituminous strips and center over treated construction and contraction joints and cracks exceeding a width of 1/16 inch.

G. Bridge and cover isolation joints expansion joints and discontinuous deck-to-wall and deck-to-deck joints with overlapping modified bituminous strips.

H. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

I. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

3.3 JOINT TREATMENT IN PREPARATION FOR INSTALLATION OF FLUID-APPLIED MEMBRANE

A. Concrete and Masonry: Prepare, treat, rout, and fill joints and cracks in substrate according to ASTM C 1193 and air barrier manufacturer's written instructions. Remove dust and dirt from joints and cracks complying with ASTM D 4258 before coating surfaces.

1. Prime substrate and apply a single thickness of preparation coat strip extending a minimum of 3 inches along each side of joints and cracks. Apply a double thickness of air barrier membrane and embed a joint reinforcing strip in preparation coat.

B. Gypsum Sheathing: Fill joints greater than 1/4 inch with sealant according to ASTM C 1193 and with air barrier manufacturer's written instructions. Apply first layer of fluid air barrier membrane at joints. Tape joints with joint reinforcing strip after first layer is dry. Apply a second layer of fluid air barrier membrane over joint reinforcing strip.

3.4 TRANSITION STRIP INSTALLATION

A. Install strips, transition strips, and auxiliary materials according to air barrier manufacturer's written instructions to form a seal with adjacent construction and maintain a continuous air barrier.

1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
2. Install butyl or modified bituminous strip on roofing membrane or base flashing so that a minimum of 3 inches of coverage is achieved over both substrates.

B. Apply primer to substrates at required rate and allow to dry. Limit priming to areas that will be covered by air barrier sheet in same day. Reprime areas exposed for more than 24 hours.

1. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.

C. Connect and seal exterior wall air barrier membrane continuously to roofing membrane air barrier, concrete below-grade structures, floor-to floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.

D. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.

E. Apply joint sealants forming part of air barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

F. Wall Openings: Prime concealed perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply [modified bituminous transition strip] [adhesive-coated transition strip] [elastomeric flashing sheet] [preformed silicone-sealant extrusion] so that a minimum of 3 inches of coverage is achieved over both substrates. Maintain 3 inches of full contact over firm bearing to perimeter frames with not less than 1 inch of full contact.

1. Transition Strip: Roll firmly to enhance adhesion.
2. Elastomeric Flashing Sheet: Apply adhesive to wall, frame, and flashing sheet. Install flashing sheet and termination bars, fastened at 6 inches o.c. Apply lap sealant over exposed edges and on cavity side of flashing sheet.
3. Preformed Silicone-Sealant Extrusion: Set in full bed of silicone sealant applied to walls, frame, and membrane.

G. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air barrier membrane with foam sealant.

H. Seal strips and transition strips around masonry reinforcing or ties and penetrations with termination mastic.

I. Seal top of through-wall flashings to air barrier with an additional 6-inch-wide, modified bituminous strip.

J. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.

K. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches beyond repaired areas in strip direction.

3.5 INSTALLATION OF FLUID-APPLIED MEMBRANE AIR BARRIER

A. Apply air barrier membrane to form a seal with strips and transition strips and to achieve a continuous air barrier according to air barrier manufacturer's written instructions.

B. Apply air barrier membrane within manufacturer's recommended application temperature ranges.

C. Apply primer to substrates at required rate and allow to dry. Limit priming to areas that will be covered by air barrier sheet in same day. Reprime areas exposed for more than 24 hours.

1. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.

D. Apply a continuous unbroken air barrier to substrates according to the following minimum thickness. Apply membrane in full contact around protrusions such as masonry ties.

1. Vapor-Retarding Membrane Air Barrier: 60-mil dry film thickness.

E. Apply strip and transition strip a minimum of 1 inch onto cured air membrane or strip and transition strip over cured air membrane overlapping 3 inches onto each surface according to air barrier manufacturer's written instructions.

F. Do not cover air barrier until it has been tested and inspected by Owner's testing agency.

G. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air barrier components.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. Inspections: Air barrier materials and installation are subject to inspection for compliance with requirements. Inspections may include the following:

1. Continuity of air barrier system has been achieved throughout the building envelope with no gaps or holes.
2. Continuous structural support of air barrier system has been provided.
3. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
4. Site conditions for application temperature and dryness of substrates have been maintained.
5. Maximum exposure time of materials to UV deterioration has not been exceeded.
6. Surfaces have been primed.
7. Laps in sheet materials have complied with the minimum requirements and have been shingled in the correct direction (or mastic applied on exposed edges), with no fishmouths.
8. Termination mastic has been applied on cut edges.
9. Air barrier has been firmly adhered to substrate.
10. Compatible materials have been used.
11. Transitions at changes in direction and structural support at gaps have been provided.
12. Connections between assemblies (membrane and sealants) have complied with requirements for cleanliness, preparation, and priming of surfaces, structural support, integrity, and continuity of seal.
13. All penetrations have been sealed.

C. Tests:

1. Qualitative Testing: Air barrier assemblies will be tested for evidence of air leakage according to ASTM E 1186.
2. Quantitative Air Leakage Testing: Testing not to exceed the test pressure differential, positive and negative, indicated in "Performance Requirements" Article for air barrier assembly air leakage according to ASTM E 283.

D. Remove and replace deficient air barrier components and retest as specified above.

3.7 CLEANING AND PROTECTION

A. Protect air barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.

1. Protect air barrier from exposure to UV light and harmful weather exposure as required by manufacturer. Remove and replace air barrier exposed to these conditions for more than 30 days.
2. Protect air barrier from contact with creosote, uncured coal-tar products, TPO, EPDM, flexible PVC membranes, and sealants not approved by air barrier manufacturer.

B. Clean spills, stains, and soiling from adjacent construction that would be exposed in the completed work using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 07 27 00

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Metal-faced composite wall panels and attachment systems; Type MP-1 at curtain wall and parapet wall systems.
2. Metal-faced composite wall panels and attachment systems; Type MP-2 along cornices at masonry walls.
3. Factory-formed and -assembled, foamed-insulation-core metal wall panels; Type MP-3 at exterior walls at Cooling Tower enclosure.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 05 40 00 - COLD-FORMED METAL FRAMING for secondary support framing supporting metal wall panels.
2. Section 07 21 00 - THERMAL INSULATION for insulation behind metal wall panels.
3. Section 07 62 00 - SHEET METAL FLASHING AND TRIM for copings, flashings, and other sheet metal work not part of metal wall panel assemblies.
4. Section 07 92 00 - JOINT SEALANTS for field-applied sealants not otherwise specified in this Section.

1.3 PERFORMANCE REQUIREMENTS

A. General: Provide metal wall panel assemblies that comply with performance requirements specified as determined by testing manufacturers' standard assemblies similar to those indicated for this Project, by a qualified testing and inspecting agency.

B. Delegated Design: Design metal wall panel assembly, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

C. Structural Performance: Provide metal wall panel assemblies capable of withstanding the effects of gravity loads and loads and stresses within limits and under conditions indicated, based on testing according to ASTM E 1592 and ASTM E 330 as applicable.

1. Wind Loads: As required by Code and as indicated on the Structural Drawings.
2. Deflection Limits: Engineer metal wall panel assemblies to withstand test pressures with deflection no greater than 1/180 of the span and no evidence of material failure, structural distress, or permanent deformation exceeding 0.2 percent of the clear span, at code required loading.

D. Thermal Movements for Metal-Faced Composite Wall Panels: Provide composite wall panel assemblies that allow for noiseless thermal movements resulting from the following range in ambient temperatures and that prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects:

1. Ambient Temperature Range: Minus 20 to plus 180 deg F.

1.4 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal wall panel and accessory.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.
3. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.

C. Delegated-Design Submittal: For metal wall panel assembly indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

D. Shop Drawings: Show fabrication and installation layouts of metal wall panels; details of edge conditions, joints, panel profiles, sealant type, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details. Distinguish between factory- and field-assembled work.

E. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.

1. Metal Panels: 12 inches long by actual panel width. Include fasteners, closures, and other metal wall panel accessories. Include 4-way joint for composite panels.
2. Exposed Sealants: For each type and color of joint sealant required. Install joint sealants in 1/2-inch-wide joints formed between two 6-inch-long strips of material matching the appearance of metal wall panels adjacent to joint sealants.

F. Qualifications: Qualifications of professional engineer and qualifications of installer as specified.

1.5 QUALITY ASSURANCE

A. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the state the project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of panels that are similar to those indicated for this Project in material, design, and extent.

B. Installer Qualifications: An employer of workers trained and approved by manufacturer.

1. Installer's responsibilities include fabricating and installing metal wall panel assemblies and providing professional engineering services needed to assume engineering responsibility.
2. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.

C. Fabricator Qualifications: Certified by metal-faced composite wall panel manufacturer to fabricate and install manufacturer's wall panel system.

D. Source Limitations: Obtain each type of metal wall panel through one source from a single manufacturer.

E. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.

1. Use manufacturer's standard test methods to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.

F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01. Review methods and procedures related to metal wall panel assemblies including, but not limited to, the following:

1. Meet with The Owner, Architect, Owner’s insurer if applicable, testing and inspecting agency representative, metal wall panel Installer, metal wall panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal wall panels including installers of doors, windows, and louvers.
2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review methods and procedures related to metal wall panel installation, including manufacturer's written instructions.
4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
5. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that will affect metal wall panels.
6. Review governing regulations and requirements for insurance, certificates, and testing and inspecting if applicable.
7. Review temporary protection requirements for metal wall panel assembly during and after installation.
8. Review wall panel observation and repair procedures after metal wall panel installation.
9. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

G. Mockups: Provide mock-ups as specified in Section 01 45 00 - QUALITY CONTROL, coordinate with other trades as required. Refer to Architectural Drawings for mock-up locations.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, sheets, metal wall panels, and other manufactured items so as not to be damaged or deformed. Package metal wall panels for protection during transportation and handling.

B. Unload, store, and erect metal wall panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal wall panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal wall panels to ensure dryness, with positive slope for drainage of water. Do not store metal wall panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Store metal-faced composite wall panels vertically, covered with suitable weathertight and ventilated covering. Store metal-faced composite wall panels to ensure dryness, with positive slope for drainage of water. Do not store metal-faced composite wall panels in contact with other materials that might cause staining, denting, or other surface damage. Do not allow storage space to exceed 120 deg F.

E. Protect strippable protective covering on metal wall panels from exposure to sunlight and high humidity, except to extent necessary for period of metal wall panel installation.

1.7 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal wall panels to be performed according to manufacturers' written instructions and warranty requirements.

B. Field Measurements: Verify locations of structural members and wall opening dimensions by field measurements before metal wall panel fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, either establish framing and opening dimensions and proceed with fabricating metal wall panels without field measurements, or allow for field trimming of panels. Coordinate wall construction to ensure that actual building dimensions, locations of structural members, and openings correspond to established dimensions.

1.8 COORDINATION

A. Coordinate metal wall panel assemblies with rain drainage work, flashing, trim, and construction of girts, studs, soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal wall panel assemblies that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Structural failures, including rupturing, cracking, or puncturing.
   b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
2. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal wall panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
   a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
   b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
   c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 METAL-FACED COMPOSITE WALL PANELS (MP-1 and MP-2)

A. General: Provide factory-formed and -assembled metal-faced composite wall panels fabricated from two metal facings bonded, using no glues or adhesives, to solid extruded thermoplastic core; formed into profile for installation method indicated. Include attachment system components and accessories required for weathertight system.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. CENTRIA Architectural Systems; Formabond II Wall System.
2. 3A Composites USA, Inc.; Alucobond.
3. Alcoa Inc.; Reynobond.
4. Firestone Metal Products, LLC; UNA-FAB Series 1000.
5. Protean Construction Products, Inc.; ACM 100.

C. Aluminum-Faced Composite Wall Panels Smooth surface, formed with 0.020-inch- thick, coil-coated aluminum sheet facings, panel thickness 0.157 inch (4 mm).

D. Attachment System Components: Formed from extruded aluminum. Include manufacturer's standard perimeter extrusions, panel stiffeners, panel clips and anchor channels.

E. Trim: Same material, finish, and color as facings of adjacent composite panels, unless otherwise indicated.

F. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide exposed fasteners with heads matching color of metal wall panels by means of plastic caps or factory-applied coating.

1. Fasteners for Wall Panels: Self-drilling or self-tapping, zinc-plated, hex-head carbon-steel screws, with a stainless-steel cap or zinc-aluminum-alloy head and EPDM or neoprene sealing washer.
2. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws with hex washer head.
3. Blind Fasteners: High-strength aluminum or stainless-steel rivets.

2.2 FOAMED-INSULATION-CORE METAL WALL PANELS (MP-3)

A. General: Provide factory-formed and -assembled metal wall panels fabricated from two metal facing sheets and insulation core foamed-in-place during fabrication with joints between panels designed to form weathertight seals. Include accessories required for weathertight installation.

1. Panel Performance:

a. Flatwise Tensile Strength: 30 psi when tested according to ASTM C 297.
b. Humid Aging: Volume increase not greater than 6.0 percent and no delamination or metal corrosion when tested for 7 days at 140 deg F and 100 percent relative humidity according to ASTM D 2126.
c. Heat Aging: Volume increase not greater than 2.0 percent and no delamination, surface blistering, or permanent bowing when tested for 7 days at 200 deg F according to ASTM D 2126.
d. Cold Aging: Volume decrease not more than 1.0 percent and no delamination, surface blistering, or permanent bowing when tested for 7 days at minus 20 deg F according to ASTM D 2126.
e. Fatigue: No evidence of delamination, core cracking, or permanent bowing when tested to a 20-lbf/sq. ft. positive and negative wind load and with deflection of L/180 for 2 million cycles.
f. Autoclave: No delamination when exposed to 2-psi pressure at a temperature of 212 deg F for 2-1/2 hours.
g. Fire-Test-Response Characteristics: Class A according to ASTM E 108.
h. Thermal Performance: ASTM E 1363.

2. Isocyanurate Insulation-Core Performance:

a. Density: 2.0 to 2.6 lb/cu. ft. when tested according to ASTM D 1622.
b. Compressive Strength: Minimum 20 psi when tested according to ASTM D 1621.
c. Shear Strength: 26 psi when tested according to ASTM C 273.

B. Concealed-Fastener, Foamed-Insulation-Core Metal Wall Panels: Formed with tongue-and-groove panel edges; designed for sequential installation by interlocking panel edges and mechanically attaching panels to supports using concealed clips or fasteners.

1. Available Products:

a. Aluma Shield Industries, Inc., a Member of Metecno Group; AW-300A Flush Wall Panel.
b. CENTRIA Architectural Systems; Formawall Dimension Series.

c. Metl-Span; CF Architectural Wall Panel.

2. Facings: Fabricate panel with exterior and interior facings of same material and thickness.

a. Material: Zinc-coated (galvanized) G90 steel sheet, 22 gauge thick at exterior panel and 26 gauge at interior panel.
b. Interior Facing Finish: Manufacturer's standard 0.2 mil primer with 0.6 mil acrylic.
c. Exterior Surface: Smooth, flat.

3. Panel Thickness: 3.0 inches; 13/16 in. thick at reveals.
4. Panel Module: 24 in.

2.3 ACCESSORIES

A. Wall Panel Accessories: Provide components required for a complete metal wall panel assembly including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal wall panels, unless otherwise indicated.

B. Trim: Formed from 0.0179-inch-thick, zinc-coated (galvanized) steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal wall panels.

C. Sealant: Provide sealant as recommended by manufacturer and in compliance with requirements of Section 079200 – JOINT SEALANTS.

2.4 METAL FRAMING

A. Steel Sheet Components, General: Complying with ASTM C 645 requirements for metal and with ASTM A 653, G60 , hot-dip galvanized zinc coating.

B. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches wall attachment flange of 7/8 inch, minimum bare metal thickness of 0.0179 inch and depth required to fit insulation thickness indicated.

C. Rainscreen System: Provide system that has been tested in accordance with AAMA 508-05 (Pressure Equalized Rain Screen Wall Cladding Test) – Standard Test Method for Water Penetration of Exterior Vented Rainscreen Panel System. The test requires a minimum airflow of 1 CFM / SF of weather wall area through the vented rainscreen system to replicate severe storm and imperfection in air/vapor barrier system. While maintaining 1 CFM/SF airflow, the system must be able to pressure equalize and sustain zero pressure difference between the interior and exterior wall cavity without any water penetration.

1. Manufacturers: Universe Systems, Division of Universe Corporation; LYMO Architectural Panel Systems Inc.; POHL Inc. of America; Centria Architectural Systems; Metal Sales & Service, Inc.; or approved equal.
2. Rout and return wall panel system with dry joints for rainscreen assembly; as approved by the Architect.

D. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

2.5 FABRICATION

A. General: Fabricate and finish metal wall panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

1. Form panel lines, breaks, and angles to be sharp and true, with surfaces free from warp and buckle.
2. Fabricate wall panels with panel stiffeners as required to maintain fabrication tolerances and to withstand design loads.

B. Metal-Faced Composite Wall Panels: Factory form panels. Trim and square edges of sheets with no displacement of face sheets or protrusion of core material.

1. Fabricate panels with panel stiffeners, as required to comply with deflection limits, attached to back of panels with structural silicone sealant or bond tape.
2. Fabricate panels with sharply cut edges, with no displacement of face sheets or protrusion of core material.
3. Dimensional Tolerances:

a. Length: Plus 0.375 inch.
b. Width: Plus 0.188 inch.
c. Thickness: Plus or minus 0.008 inch.
d. Panel Bow: 0.8 percent maximum of panel length or width.
e. Squareness: 0.2 inch maximum.

C. Sheet Metal Accessories: Fabricate trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
4. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended by metal wall panel manufacturer.

a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

2.6 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Fluoropolymer Two-Coat Finish System: Manufacturer's standard two-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color coat, with topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight, with a minimum total dry film thickness of 1.5 mil; complying with AAMA 2605.

1. Color and Gloss: Match Valspar Fluoropon Classic II, Champagne Gold, Pearlescent/Mica Fleck Finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal wall panel supports, and other conditions affecting performance of work.

1. Examine primary and secondary wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal wall panel manufacturer.
2. Examine solid wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal wall panel manufacturer.
3. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.

B. Examine roughing-in for components and systems penetrating metal wall panels to verify actual locations of penetrations relative to seam locations of metal wall panels before metal wall panel installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of substances harmful to insulation, including removing projections capable of interfering with insulation attachment.

B. Miscellaneous Framing: Install subgirts, base angles, sills, furring, and other miscellaneous wall panel support members and anchorage according to ASTM C 754 and metal wall panel manufacturer's written recommendations.

3.3 METAL WALL PANEL INSTALLATION, GENERAL

A. General: Install metal wall panels in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to girts and subgirts, unless otherwise indicated. Anchor metal wall panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Field cutting of metal wall panels by torch is not permitted.
2. Shim or otherwise plumb substrates receiving metal wall panels.
3. Rigidly fasten base end of metal wall panels and allow eave end free movement due to thermal expansion and contraction. Predrill panels.
4. Flash and seal metal wall panels with weather closures at eaves, rakes, and at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until weather barrier and flashings that will be concealed by metal wall panels are installed.
5. Install screw fasteners in predrilled holes.
6. Locate and space fastenings in uniform vertical and horizontal alignment.
7. Install flashing and trim as metal wall panel work proceeds.
8. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
9. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete, and elsewhere as indicated or, if not indicated, as necessary for waterproofing.
10. Align bottom of metal wall panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
11. Provide weatherproof escutcheons for pipe and conduit penetrating exterior walls.

B. Fasteners, Aluminum Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior and aluminum or galvanized steel fasteners for surfaces exposed to the interior.

C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal wall panel manufacturer.

3.4 WALL PANEL INSTALLATION

A. General: Install attachment system required to support wall panels and to provide a complete weathertight wall system, including subgirts, perimeter extrusions, tracks, drainage channels, panel clips, and anchor channels.

1. Include attachment to supports, panel-to-panel joinery, panel-to-dissimilar-material joinery, and panel-system joint seals.
2. Do not begin installation until weather barrier and flashings that will be concealed by composite panels are installed.

B. Track-Support Installation: Provide manufacturer's standard horizontal and vertical tracks that provide support and complete secondary drainage system, draining to the exterior at horizontal joints. Install support system at locations, spacings, and with fasteners recommended by

manufacturer. Attach panels to wall by interlocking tracks with perimeter extrusions attached to wall panels. Fully engage integral gaskets and leave horizontal and vertical joints with open reveal.

1. Attach routed-and-returned flanges of wall panels to perimeter extrusions with manufacturer's standard fasteners.

3.5 ACCESSORY INSTALLATION

A. General: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal wall panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.

B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

1. Install exposed flashing and trim that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3.6 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align metal wall panel units within installed tolerance of 1/4 inch in 20 feet nonaccumulative, on level, plumb, and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.7 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal wall panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal wall panel installation, clean finished surfaces as recommended by metal wall panel manufacturer. Maintain in a clean condition during construction.

B. After metal wall panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

C. Replace metal wall panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 42 00

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Fiber-cement siding and batten trim at Mechanical attic.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 018110, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 061000 - ROUGH CARPENTRY for wood furring, grounds, nailers, and blocking.
2. Section 061600 - SHEATHING for wall sheathing.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Verification: For each type, color, texture, and pattern required.

1. 12-inch- (300-mm-) long-by-actual-width Sample of siding.
2. 12-inch- (300-mm-) long-by-actual-width Samples of trim and accessories.

C. Product Certificates: For each type of siding and trim, from manufacturer.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for fiber-cement siding.

E. Warranty: Sample of special warranty.

F. Maintenance Data: For each type of siding and trim and related accessories to include in maintenance manuals.

G. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Furnish full lengths of siding and trim including related accessories, in a quantity equal to 2 percent of amount installed.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain each type, color, texture, and pattern of siding and trim, including related accessories, from single source from single manufacturer.

B. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockups for siding and trim including accessories.

a. Size: 48 inches long by 60 inches high.
b. Include outside corner on one end of mockup and inside corner on other end.

2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

C. Preinstallation Conference: Conduct conference at Project site. Comply with requirements in Division 01.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials in a dry, well-ventilated, weathertight place.

1.6 COORDINATION

A. Coordinate installation with flashings and other adjoining construction to ensure proper sequencing.

1.7 WARRANTY

A. Special Warranty: Standard form in which manufacturer agrees to repair or replace siding and trim that fail(s) in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including cracking, deforming, and fading.
b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Fading is defined as loss of color, after cleaning with product recommended by manufacturer, of more than 5 Hunter color-difference units as measured according to ASTM D 2244.
3. Warranty Period: 25 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 FIBER-CEMENT SIDING PANELS AND TRIM

A. General: Siding panels made from fiber-cement board that complies with ASTM C 1186, Type A, Grade II; is classified as noncombustible when tested according to ASTM E 136; and has a flame-spread index of 25 or less when tested according to ASTM E 84.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Cemplank.
   b. CertainTeed Corp.
   c. GAF Materials Corporation.
   d. Nichiha Fiber Cement.
2. Vertical Pattern: Panels 5/16 inches thick x wide x 120 inches high in plain style and smooth texture.
3. Factory Priming: Manufacturer's standard acrylic primer.

B. Labeling: Provide fiber-cement siding that is tested and labeled according to ASTM C 1186 by a qualified testing agency acceptable to authorities having jurisdiction.

2.2 ACCESSORIES

A. Siding Accessories, General: Provide starter strips, edge trim, outside and inside corner caps, and other items as recommended by siding manufacturer for building configuration.

1. Provide accessories made from same material as adjacent siding unless otherwise indicated.

B. Decorative Accessories: Provide the following fiber-cement decorative accessories as indicated on the Drawings.

1. Colors for Decorative Accessories: As selected by Architect from manufacturer's full range of industry colors.

C. Flashing: Provide stainless-steel flashing complying with Section 076200 - SHEET METAL FLASHING AND TRIM at window and door heads and where indicated.

D. Fasteners:

1. For fastening fiber-cement and PVC, use stainless-steel fasteners.
2. For fastening to wood, use siding nails or ribbed bugle-head screws of sufficient length to penetrate a minimum of 1 inch into substrate.
3. For fastening to metal, use ribbed bugle-head screws of sufficient length to penetrate a minimum of 1/4 inch, or three screw-threads, into substrate.
4. Staples, small brads, and wire nails will not be accepted.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of siding and trim and related accessories.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of projections and substances detrimental to application.

3.3 INSTALLATION

A. General: Comply with siding and trim manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.

1. Do not install damaged components.

B. Install fiber-cement siding and trim and related accessories.

1. Install fasteners no more than 24 inches o.c. horizontally and 2 inches from ends.
2. Install minimum of two fasteners at each bearing for PVC boards up to 6 in. wide, three fasteners for boards up to 10 in. wide.
3. Align fasteners to engage framing member behind sheathing.
4. Install siding for average 5 in. exposure, adjusting as required to align courses with window and door openings.

C. Install joint sealants as specified in Section 079200 - JOINT SEALANTS and to produce a weathertight installation.

3.4 ADJUSTING AND CLEANING

A. Remove damaged, improperly installed, or otherwise defective materials and replace with new materials complying with specified requirements.

B. Clean finished surfaces according to manufacturer's written instructions and maintain in a clean condition during construction.

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Adhered membrane-roofing system.
2. Cover board.
3. Roof insulation.
4. Flashing for equipment mounted on roofing and roofing penetrations.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 06 10 00 - ROUGH CARPENTRY for wood nailers, curbs, and blocking.
2. Section 07 62 00 - SHEET METAL FLASHING AND TRIM for metal roof penetration flashings, flashings, and counterflashings.
3. Section 07 92 00 - JOINT SEALANTS for sealants.
4. Division 22 - PLUMBING for roof drains.
5. Division 23 - HEATING, VENTILATING, AND AIR CONDITIONING for roof curbs for HVAC equipment.

1.3 DEFINITIONS

A. Roofing Terminology: Refer to ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" for definition of terms related to roofing work in this Section.

1.4 PERFORMANCE REQUIREMENTS

A. General: Provide installed roofing membrane and base flashings that remain watertight; do not permit the passage of water; and resist specified uplift pressures, thermally induced movement, and exposure to weather without failure.

B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by roofing manufacturer based on testing and field experience.

C. Roofing System Design: Roofing system shall be designed to withstand Code required loads and wind speeds. Refer to Structural Drawings for requirements.

D. FM Global Listing: Roofing, base flashings, and component materials shall comply with requirements in FM Global 4450 or FM Global 4470 as part of a built-up roofing system, and shall be listed in FM Global's "RoofNav" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Global markings.

1. Fire/Windstorm Classification: Class 1A-90.
2. Hail-Resistance Rating: MH.
3. Roofing components, including but not limited to, roof cover membranes, cover boards, insulations boards (both tapered and flat), adhesives, seam tapes, mechanical fasteners, fastening plates, thermal barriers, vapor barriers and steel deck panels, steel deck fasteners and perimeter edge flashing systems should be FM Approved. These items should be listed in the FM Approval Guide or RoofNav software.
   a. An FM Global RoofNav Assembly should be installed for each roof area at this site. A RoofNav Assembly (and associated Assembly #) that is Approved for use on steel deck, as well as a second RoofNav Assembly (and associated Assembly #) that is Approved for use on a concrete deck should be selected.
4. Each RoofNav assembly should be selected based on the corner uplift classification requirement listed below for each roof area. Each assembly should be installed in all zones (field, perimeter corner) within the particular roof area.
5. Upon selecting a RoofNav Assembly Number based on the above criteria, specific component selections within the assembly, which are intended for use during final installation, should be made.
   a. The same assembly chosen to be installed on areas featuring concrete deck should have a Classification of 135 or higher, and should be identically installed on all concrete deck roof areas included in this project.

E. Flashings: Provide base flashings, perimeter flashings, detail flashings and component materials that comply with requirements and recommendations in FMG 1-49 Loss Prevention Data Sheet for Perimeter Flashings; FMG 1-29 Loss Prevention Data Sheet for Above Deck Roof Components; NRCA Roofing and Waterproofing Manual (Fourth Edition) for Construction Details and SMACNA Architectural Sheet Metal Manual (Fifth Edition) for Construction Details, as applicable.

F. Fire Performance: Provide roofing system with UL Class A.

G. Energy Performance: Provide roofing system with Solar Reflectance Index (SRI) not less than 78 when calculated according to ASTM E 1980 based on testing identical products by a qualified testing agency.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. LEED Submittals:

1. Credit SS 7.2: Product Test Reports indicating that roof materials comply with Solar Reflectance Index requirement.

C. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other Work.

1. Base flashings and membrane terminations.
2. Tapered insulation, including slopes.
3. Insulation fastening patterns.

D. FM Certification: A Contractors Package, created within RoofNav, in addition to FM Global Form 2688, Checklist for Roofing Systems, shall be created for each roof area. These documents shall be review by FM Global prior to the purchase of materials or start of work.

E. Installer Certificates: Signed by roofing system manufacturer certifying that Installer is approved, authorized, or licensed by manufacturer to install roofing system.

F. Qualification Data: For Installer and manufacturer.

G. Maintenance Data: For roofing system to include in maintenance manuals.

H. Inspection Report: Copy of roofing system manufacturer's inspection report of completed roofing installation.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain components for roofing system from or approved by roofing system manufacturer.

B. Manufacturer Qualifications: A qualified manufacturer that is FM Global approved for roofing system identical to that used for this Project.

C. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

D. Roofing Inspector: Owner may engage a full-time roofing inspector during installation of the deck, insulation assembly, membrane, flashing and other appurtenances, and when a survey of the roof and roof drains is conducted. Cooperate with Owner’s roofing inspector and allow unlimited access to roofing during construction.

E. Preinstallation Conference: Conduct conference at Project site. Comply with requirements in Division 01. Review methods and procedures related to roofing system including, but not limited to, the following:

1. Meet with the Owner, Architect, Owner’s insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.

5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.

1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

1.8 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.9 WARRANTY

A. Roofing Contractor’s Warranty: The roofing subcontractor shall supply Owner with a minimum two-year workmanship warranty for each roof. In the event any work related to the roofing, flashing, or metalwork is found to be defective within two years of substantial completion, the roofing contractor shall remove and replace such at no additional cost to the Owner. The roofing subcontractor’s warranty obligation shall run directly to the Owner, and a copy the roofing signed warranty shall be sent to the roofing system’s manufacturer.

1. The duration of the Roofing Contractor’s two-year warranty shall run concurrent with the roofing system’s manufacturer’s 20-year warranty.

B. Roofing Systems Manufacturer’s Warranty: The roofing manufacturer shall guarantee roof areas to be in a watertight condition, for a period of 20 years, from the date of final acceptance of the roofing system. The warranty shall be a 20-year no dollar limit (NDL), non-prorated total system labor and material warranty, for wind speeds up to 72 miles per hour. Total system warranty shall include all roofing materials, related components and accessories including, but not limited to the substrate board, vapor retarder, insulation board, cover board, roofing membrane,

membrane flashings, fasteners, adhesives, metal roof copings, metal roof edges and termination metals and roof drain assemblies. The manufacturer shall repair defects in materials and workmanship as promptly after observation as weather and site conditions permit.

PART 2 - PRODUCTS

2.1 PVC ROOFING MEMBRANE

A. PVC Sheet: ASTM D 4434, Type III, fabric reinforced.

1. Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Dow Roofing Systems.
b. Duro-Last Roofing, Inc.
c. GAF Materials Corporation.
d. GenFlex Roofing Systems.
e. Sarnafil Inc.
f. Stevens Roofing Systems.

2. Thickness: 80 mils, nominal.
3. Exposed Face Color: White.

B. Basis-of-Design: G410 Energy Smart by Sarnafil Inc.

2.2 AUXILIARY MATERIALS

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with membrane roofing.

1. Liquid-type auxiliary materials shall meet VOC limits of authorities having jurisdiction.

B. Sheet Flashing: Stainless steel clad flashing:

1. PVC-coated heat-weldable sheet metal capable of being formed into shapes and profiles indicated.
2. 24 gauge, stainless steel sheet with 20 mil (0.5mm) unsupported PVC membrane laminated on one side.
3. Color: As selected by the Architect.
4. Basis-of-Design: Sarnaclad.

C. Bonding Adhesive: Manufacturer's standard bonding adhesive for membrane, and solvent-based bonding adhesive for base flashings.

D. Metal Termination Bars: Manufacturer's standard predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.

E. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening membrane to substrate, and acceptable to membrane roofing system manufacturer.

F. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, termination reglets, cover strips, and other accessories.

2.3 ROOF INSULATION

A. General: Provide preformed roof insulation boards that comply with requirements and referenced standards, selected from manufacturer's standard sizes and of thicknesses indicated.

B. Extruded-Polystyrene Board Insulation: ASTM C 578, Type IV, 1.6-lb/cu. ft. minimum density, square edged.

1. Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. DiversiFoam Products.
b. Dow Chemical Company.
c. Owens Corning.
d. Tenneco Building Products.
e. Premiere Industries Insulfoam.
f. Stevens Roofing Systems

C. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches unless otherwise indicated.

D. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

2.4 INSULATION ACCESSORIES

A. General: Furnish roof insulation accessories recommended by insulation manufacturer for intended use and compatible with membrane roofing.

B. Cold Fluid-Applied Adhesive: Manufacturer's standard cold fluid-applied adhesive formulated to adhere roof insulation to substrate.

C. Cover Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, 1/2 inch thick.

1. Basis-of-Design Product: Georgia-Pacific Gypsum LLC; Dens-Deck Prime Roof Board.

2.5 WALKWAYS

A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, solid-rubber, slip-resisting, surface-textured walkway pads or rolls approximately 3/16 inch thick, and acceptable to membrane roofing system manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:

1. Verify that roof openings and penetrations are in place and set and braced and that roof drains are securely clamped in place.
2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
3. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.
4. Verify that concrete substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
5. Verify that concrete curing compounds that will impair adhesion of roofing components to roof deck have been removed.
6. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

C. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

3.3 INSULATION AND COVERBOARD INSTALLATION

A. Coordinate installing membrane roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.

B. Comply with membrane roofing system manufacturer's written instructions for installing roof insulation and coverboard.

C. Install tapered insulation under area of roofing to conform to slopes indicated.

D. Install one or more layers of insulation under area of roofing to achieve required thickness. Install 2 or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches in each direction.

E. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.

F. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch with insulation.

1. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.

G. Adhered Insulation at Concrete Deck: Install each layer of insulation and adhere to substrate as follows:

1. Prime surface of concrete deck with asphalt primer at rate of 3/4 gal./100 sq. ft., and allow primer to dry.
2. Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

H. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches in each direction. Loosely butt cover boards together.

1. Fasten cover boards according to requirements in FM Global's "RoofNav" for specified Windstorm Resistance Classification.
2. Set cover boards in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining cover board in place.

3.4 ADHERED ROOFING MEMBRANE INSTALLATION

A. Install roofing membrane over area to receive roofing according to membrane roofing system manufacturer's written instructions. Unroll roofing membrane and allow to relax before installing.

1. For PVC membrane, install sheet according to ASTM D 5036.

B. Start installation of roofing membrane in presence of membrane roofing system manufacturer's technical personnel.

C. Accurately align roofing membrane and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

D. Bonding Adhesive: Apply solvent-based bonding adhesive to substrate and underside of roofing membrane at rate required by manufacturer and allow to partially dry before installing roofing membrane. Do not apply bonding adhesive to splice area of roofing membrane.

E. Mechanically or adhesively fasten roofing membrane securely at terminations, penetrations, and perimeter of roofing.

F. Apply roofing membrane with side laps shingled with slope of roof deck where possible.

G. Seams: Clean seam areas, overlap roofing membrane, and hot-air weld side and end laps of roofing membrane according to manufacturer's written instructions to ensure a watertight seam installation.

1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roofing membrane.

2. Verify field strength of seams a minimum of twice daily and repair seam sample areas.
3. Repair tears, voids, and lapped seams in roofing membrane that does not meet requirements.

H. Spread sealant or mastic bed over deck drain flange at deck drains and securely seal roofing membrane in place with clamping ring.

3.5 BASE FLASHING INSTALLATION

A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions.

B. Apply solvent-based bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply bonding adhesive to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

D. Clean splice areas, apply splicing cement (except for heat-welded application), and firmly roll side and end laps of overlapping sheets to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of sheet flashing terminations.

E. Terminate and seal top of sheet flashings.

3.6 WALKWAY INSTALLATION

A. Flexible Walkways: Install walkway products in locations indicated. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform roof tests and inspections and to prepare test reports.

B. Manufacturer’s Technical Representative: Engage a qualified manufacturer’s technical representative to perform roof tests and inspections and to prepare test reports.

C. Final Roof Inspection: Engage roofing system manufacturer's technical personnel to inspect roofing installation on completion and submit report to Architect.

1. Notify Architect and the Owner 48 hours in advance of date and time of inspection.

D. Repair or remove and replace components of membrane roofing system where test results or inspections indicate that they do not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.8 PROTECTING AND CLEANING

A. Protect membrane-roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and the Owner.

B. Correct deficiencies in or remove membrane-roofing system that does not comply with requirements, repair substrates, and repair or reinstall membrane-roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 07 54 00

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Custom-fabricated sheet steel roofing:
   a. Batten-standing-seam, steep slope, curved metal roofing.
   b. Sheathing.
   c. Underlayment.
   d. Accessories.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 06 10 00 - ROUGH CARPENTRY for wood nailers, curbs, and blocking.
2. Section 07 62 00 - SHEET METAL FLASHING AND TRIM for fasciae, copings, and flashings that are not part of sheet metal roofing.
3. Section 07 92 00 - JOINT SEALANTS for field-applied sheet metal roofing sealants.

1.3 PERFORMANCE REQUIREMENTS

A. General: Provide complete sheet metal roofing system, including, but not limited to, custom-fabricated metal roof pans, cleats, clips, anchors and fasteners, sheet metal flashing and drainage components related to sheet metal roofing, fascia panels, trim, underlayment, and accessories as indicated and as required for a weathertight installation.

B. FM Global Listing: Roofing, base flashings, and component materials shall comply with requirements in FM Global 4450 or FM Global 4470 as part of a built-up roofing system, and shall be listed in FM Global's "RoofNav" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Global markings.

1. Fire/Windstorm Classification: Class 1A-90.
2. Hail-Resistance Rating: MH.

C. Thermal Movements: Provide sheet metal roofing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing

buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of sheet metal roofing thermal movements. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

D. Water Infiltration: Provide sheet metal roofing that does not allow water infiltration to building interior, with metal flashing and connections of sheet metal roofing lapped to allow moisture to run over and off the material.

E. Energy Performance: Provide roofing system with Solar Reflectance Index (SRI) not less than 29 when calculated according to ASTM E 1980 based on testing identical products by a qualified testing agency.

1.4 SUBMITTALS

A. Product Data: For each product indicated. Include details of construction relative to materials, dimensions of individual components and profiles, and finishes.

B. LEED Submittals:

1. Credit SS 7.2: Product Test Reports indicating that roof materials comply with Solar Reflectance Index requirement.
2. Credit MR 4: Manufacturer's product data for metals having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating costs for each product having recycled content.

C. Shop Drawings: Show fabrication and installation layouts of sheet metal roofing, including plans, elevations, and keyed references to termination points. Distinguish between shop- and field-assembled work. Include the following:

1. Details for forming sheet metal roofing, including seams and dimensions.
2. Details for joining and securing sheet metal roofing, including layout of fasteners, clips, and other attachments. Include pattern of seams.
3. Details of termination points and assemblies, including fixed points.
4. Details of expansion joints, including showing direction of expansion and contraction.
5. Details of roof penetrations.
6. Details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counter flashings.
7. Details of special conditions.
8. Details of connections to adjoining work.
9. Details of the following accessory items, at a scale of not less than 1-1/2 inches per 12 inches:
   a. Flashing and trim.
   b. Roof curbs.
   c. Snow guards.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:

1. Sheet Metal Roofing: 12 inches long by actual pan width, including finished seam. Include fasteners, cleats, closures, and other attachments.
2. Trim and Closures: 12 inches long. Include fasteners and other exposed accessories.
3. Accessories: 12-inch-long Samples for each type of accessory.
   a. Snow Guards: Full-size Sample.

E. Qualification Data: For Installer and manufacturer.

F. Maintenance Data: For roofing system to include in maintenance manuals.

G. Inspection Report: Copy of roofing system manufacturer's inspection report of completed roofing installation.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain components for roofing system from or approved by roofing system manufacturer.

B. Manufacturer Qualifications: A qualified manufacturer that is FM Global approved for roofing system identical to that used for this Project.

C. Sheet Metal Roofing Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or shown on Drawings.

D. Preinstallation Conference: Conduct conference at Project site. Comply with requirements in Division 01. Review methods and procedures related to roofing system including, but not limited to, the following:

1. Meet with the Architect; Architect, Owner's insurer if applicable; testing and inspecting agency representative; roofing Installer; roofing system manufacturer's representative; deck Installer; and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver sheet metal roofing pans, components, and other sheet metal roofing materials so as not to be damaged or deformed. Package sheet metal roofing materials for protection during transportation and handling.

B. Unload, store, and erect sheet metal roofing materials in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack materials on platforms or pallets, covered with suitable weathertight and ventilated covering. Store sheet metal roofing materials to ensure dryness. Do not store sheet metal roofing materials in contact with other materials that might cause staining, denting, or other surface damage.

D. Protect strippable protective covering on sheet metal roofing from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal roofing installation.

1.7 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.8 WARRANTY

A. Special Warranty on Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace sheet metal roofing that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

B. Special Manufacturer’s Warranty:

1. Provide 20 year watertight warranty from the manufacturer.
2. Manufacturer agrees to repair or replace standing seam metal roof panel assemblies that fail to remain watertight, including leaks which occur within the specified warranty period.

C. Special Installer's Warranty: Roofing Installer's warranty, including substrates, panels, roof flashings, connections, and gutters, signed by Roofing Installer, in which Roofing Installer agrees to repair or replace components of custom-fabricated sheet metal roofing that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures.
b. Loose parts.
c. Wrinkling or buckling.
d. Failure to remain weathertight, including uncontrolled water leakage.
e. Deterioration of metals, metal finishes, and other materials beyond normal weathering, including nonuniformity of color or finish.
f. Galvanic action between sheet metal roofing and dissimilar materials.

2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. CENTRIA Architectural Systems.
2. Fabral.
3. Firestone Metal Products, LLC.
4. McElroy Metal, Inc.
5. Morin; a Kingspan Group company.

B. Basis-of-Design:

1. Steep Slope Roof: Series SRS3 by CENTRIA.
2. Curved Roof: Series SRS3-Curved by CENTRIA.

2.2 ROOFING SHEET METALS

A. Galvalume Metallic-Coated Steel Sheet, Prepainted with Coil Coating: Provide aluminum-zinc alloy-coated steel sheet according to ASTM A 792/A 792M, Class AZ50 coating designation, Grade 40 with smooth, flat surface; prepainted by coil-coating process to comply with ASTM A 755/A 755M.

1. Thickness: Minimum 22 gauge.

B. Aluminum Extrusions: ASTM B 221, alloy and temper recommended by manufacturer for type of use and finish indicated, finished as follows:

2.3 UNDERLAYMENT MATERIALS

A. Sheathing/Substrate Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, Type X, 5/8 inch thick.

1. Products: Subject to compliance with requirements, provide one of the following:

a. CertainTeed Corporation; GlasRoc Sheathing Type X.
b. Georgia-Pacific Corporation; Dens Deck Prime.
c. National Gypsum Company; Gold Bond eXP Extended Exposure Sheathing.
d. USG Corporation; Securock Glass Mat Roof Board.

B. Self-Adhering, High-Temperature Sheet: 30 to 40 mils thick minimum, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.

1. Thermal Stability: Stable after testing at 240 deg F; ASTM D 1970.
2. Low Temperature Flexibility: Passes after testing at minus 20 deg F; ASTM D 1970.

3. Available Products:

   a. Carlisle Coatings & Waterproofing, Div. of Carlisle Companies Inc.; Dri-Start "HR" High Performance Roofing Underlayment.
   b. Grace, W. R. & Co.; Vycor Ultra.
   c. Henry Company; Perma-Seal PE.
   d. TC MiraDRI; WIP 300HT.

C. Slip Sheet: Building paper, minimum 5 lb/100 sq. ft., rosin sized.

2.4 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for a complete roofing system and as recommended by fabricator for sheet metal roofing.

B. Fasteners: Self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads.

   1. Exposed Fasteners: Heads matching color of sheet metal roofing by means of plastic caps or factory-applied coating.
   2. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws with hex washer head.
   3. Blind Fasteners: Stainless steel rivets.

C. Sealing Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape.

D. Elastomeric Joint Sealant: ASTM C 920, of base polymer, type, grade, class, and use classifications required to produce joints in sheet metal roofing that will remain weathertight and as recommended by roll-formed sheet metal roofing manufacturer for installation indicated.

E. Expansion-Joint Sealant: For hooked-type expansion joints, which must be free to move, provide nonsetting, nonhardening, nonmigrating, heavy-bodied polyisobutylene sealant.

F. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.5 ACCESSORIES

A. Sheet Metal Roofing Accessories: Provide components required for a complete sheet metal roofing assembly including trim, copings, fasciae, corner units, ridge closures, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of sheet metal roofing, unless otherwise indicated.

   1. Closures: Provide closures at eaves and ridges, fabricated of same metal as sheet metal roofing.
   2. Clips: Minimum 0.0625-inch-thick, stainless steel panel clips designed to withstand negative-load requirements.
   3. Cleats: For mechanically seaming into joints and formed from the following materials:

a. Metallic-Coated Steel Roofing: 0.0250-inch- thick stainless steel.

4. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.

B. Flashing and Trim: Formed from same material and with same finish as sheet metal roofing, minimum 0.0179-inch-thick. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers.

1. Pipe and Penetration Flashing: Premolded, flashing sleeve or pipe collar with flexible metal ring bonded to sloped base. Intended to provide weatherproof seal and to isolate pipe movement from vibration and expansion/contraction.

C. Roof Curbs: Fabricated from same material and finish as sheet metal roofing, minimum thickness matching the sheet metal roofing; with bottom of skirt profiled to match roof panel profiles; with weatherproof top box and integral full-length cricket. Fabricate curb sub framing of nominal 0.062-inch- thick, angle-, C-, or Z-shaped galvanized steel or stainless steel sheet. Fabricate curb and sub framing to withstand indicated loads of size and height indicated. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

1. Factory insulate curbs with 1-inch- thick, rigid insulation.
2. Factory install wood nailers at tops of curbs.
3. Fabricate curb units with water diverter or cricket and with height tapered to match slope to level tops of units.

D. Snow Guards: Prefabricated, noncorrosive units designed to be installed without penetrating sheet metal roofing, and complete with predrilled holes, clamps, or hooks for anchoring.

1. Seam-Mounted, Bar-Type Snow Guards: Aluminum rods or bars held in place by stainless-steel clamps attached to vertical ribs of standing-seam sheet metal roofing; with pipe, end caps, couplings, collars and ice-flags.

a. Aluminum Finish: Match roofing.
b. Available Products:

1) Basis-of-Design: Alpine Snow Guard Systems, Div. of Vermont Slate & Copper Services, Inc.; Model No#4000 T2K.
2) Equal by LMCurbs.
3) Equal by Snow Management Systems, a division of Contek, Inc.; Vermont Snowguard.

E. Gutters: Fabricate to cross-section indicated, complete with end pieces, outlet tubes, and other accessories as required. Fabricate in minimum 96-inch long sections. Furnish flat-stock gutter spacers and gutter brackets fabricated from same metal as gutters, of size recommended by SMACNA but not less than twice the gutter thickness. Fabricate expansion joints, expansion-joint covers, and gutter accessories from same metal as gutters.

1. Gutter Style and Details: As indicated on Drawings.
2. Expansion Joints: Lap type.
3. Gutters: Fabricate from extruded aluminum in thicknesses recommended by SMACNA.

F. Splash Blocks: Provide precast concrete splash blocks.

2.6 FABRICATION

A. General: Custom fabricate sheet metal roofing to comply with details shown and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions (pan width and seam height), geometry, metal thickness, and other characteristics of installation indicated. Fabricate sheet metal roofing and accessories at the shop to greatest extent possible.

B. Snap-on-Batten-Seam Metal Roof Panels: Formed with vertical ribs at panel edges and intermediate stiffening ribs symmetrically spaced between ribs; designed for independent installation by mechanically attaching panels to supports using concealed clips located between panels, engaging the opposite edge of adjacent panels, and installing snap-on battens over panel joints.

1. Standing-Seam Roofing: Form standing-seam pans 18 inches wide with finished seam height of 3 inch.

C. General: Fabricate roll-formed sheet metal roofing panels to comply with details shown and roll-formed sheet metal roofing manufacturer's written instructions.

D. Fabricate sheet metal roofing to allow for expansion in running work sufficient to prevent leakage, damage, and deterioration of the Work. Form exposed sheet metal work to fit substrates without excessive oil canning, buckling, and tool marks, true to line and levels indicated, and with exposed edges folded back to form hems.

1. Lay out sheet metal roofing so cross seams, when required, are made in direction of flow with higher pans overlapping lower pans. Stagger cross seams.
2. Fold and cleat eaves and transverse seams in the shop.
3. Form and fabricate sheets, seams, strips, cleats, valleys, ridges, edge treatments, integral flashings, and other components of metal roofing to profiles, patterns, and drainage arrangements shown and as required for leakproof construction.

E. Expansion Provisions: Where lapped or bayonet-type expansion provisions in the Work cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with sealant (concealed within joints).

F. Sealant Joints: Where movable, nonexpansion-type joints are indicated or required to produce weathertight seams, form metal to provide for proper installation of elastomeric sealant, in compliance with SMACNA standards.

G. Metal Protection: Where dissimilar metals will contact each other, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by manufacturers of dissimilar metals or by fabricator.

H. Sheet Metal Accessories: Custom fabricate flashings and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated. Obtain field measurements for accurate fit before shop fabrication.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Seams: Fabricate nonmoving seams with flat-lock seams.
3. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
5. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
   a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" for application but not less than thickness of metal being secured.

2.7 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Fluoropolymer Two-Coat Finish System: Manufacturer's standard two-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color coat, with topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight, with a minimum total dry film thickness of 1.5 mil; complying with AAMA 2605.

   1. Color and Gloss: Match Valspar Fluoropon Classic II, Champagne Gold, Pearlescent/Mica Fleck Finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, sheet metal roofing supports, and other conditions affecting performance of work.

   1. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances.
   2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and completely anchored, and that provision has been made for flashings, and penetrations through sheet metal roofing.
   3. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.

B. Examine roughing-in for components and systems penetrating sheet metal roofing to verify actual locations of penetrations relative to seam locations of sheet metal roofing before sheet metal roofing installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Install flashings and other sheet metal to comply with requirements specified in Section 07 62 00 - SHEET METAL FLASHING AND TRIM.

3.3 UNDERLAYMENT INSTALLATION

A. Sheathing/Substrate Board: Install substrate board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.

1. Fasten substrate board to top flanges of steel deck according to recommendations in FM Global's "RoofNav" and FM Global Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification.

B. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free, on roof sheathing under sheet metal roofing. Apply primer if required by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer rather than nails for installing underlayment at low temperatures. Apply over entire roof in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.

C. Install flashings to cover underlayment to comply with requirements specified in Section 07 62 00 - SHEET METAL FLASHING AND TRIM.

D. Apply slip-sheet over underlayment before installing sheet metal roofing.

3.4 INSTALLATION, GENERAL

A. General: Install sheet metal roofing perpendicular to purlins or supports. Anchor sheet metal roofing and other components of the Work securely in place, with provisions for thermal and structural movement. Install fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for a complete roofing system and as recommended by fabricator for sheet metal roofing.

1. Field cutting of sheet metal roofing by torch is not permitted.
2. Rigidly fasten eave end of sheet metal roofing and allow ridge end free movement due to thermal expansion and contraction. Predrill roofing.
3. Provide metal closures at each side of ridge caps.
4. Flash and seal sheet metal roofing with weather closures at eaves, rakes, and at perimeter of all openings. Fasten with self-tapping screws.
5. Locate and space fastenings in uniform vertical and horizontal alignment.
6. Install ridge caps as sheet metal roofing work proceeds.
7. Locate roofing splices over, but not attached to, structural supports. Stagger roofing splices and end laps to avoid a four-panel lap splice condition.

8. Lap metal flashing over sheet metal roofing to allow moisture to run over and off the material.

B. Fasteners: Use fasteners of sizes that will not penetrate completely through substrate.

1. Steel Roofing: Use stainless-steel fasteners.

C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by fabricator of sheet metal roofing or manufacturers of dissimilar metals.

D. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

E. Fascia: Align bottom of sheet metal roofing and fasten with blind rivets, bolts, or self-tapping screws. Flash and seal sheet metal roofing with weather closures where fasciae meet soffits, along lower panel edges, and at perimeter of all openings.

3.5 CUSTOM-FABRICATED SHEET METAL ROOFING INSTALLATION

A. Fabricate and install work with lines and corners of exposed units true and accurate. Form exposed faces flat and free of buckles, excessive waves, and avoidable tool marks, considering temper and reflectivity of metal. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant. Fold back sheet metal to form a hem on concealed side of exposed edges, unless otherwise indicated.

1. Install cleats to hold sheet metal panels in position. Attach each cleat with two fasteners to prevent rotation.
2. Nail cleats not more than 12 inches o.c. Bend tabs over nails.

B. Seal joints as shown and as required for leakproof construction. Provide low-slope transverse seams using cleats where backup of moisture may occur.

1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70 deg F, set joint members for 50 percent movement either way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.
2. Prepare joints and apply sealants to comply with requirements in Section 07 92 00 - Joint Sealants.

C. Provide expansion cleats in roof panels that exceed 30 feet in length.

D. Batten-Seam Metal Roof Panel Installation: Fasten metal roof panels to supports with concealed clips at each batten-seam joint at location, spacing, and with fasteners recommended by manufacturer.

1. Install clips to supports with self-drilling fasteners.
2. Apply battens to metal roof panel seams, fully engaged to provide weathertight joints.

3. Watertight Installation:
   a. Apply a continuous ribbon of sealant or tape to seal joints of metal panels, using sealant or tape as recommend by manufacturer as needed to make panels watertight.
   b. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
   c. At panel splices, nest panels with minimum 6-inch end lap, sealed with sealant and fastened together by interlocking clamping plates.

3.6 ACCESSORY INSTALLATION

A. General: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.

   1. Install components required for a complete sheet metal roofing assembly including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.

B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

   1. Install exposed flashing and trim that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
   2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

C. Pipe and Penetration Flashing: Form flashing around pipe penetration and sheet metal roofing. Fasten and seal to sheet metal roofing as recommended by SMACNA.

D. Roof Curbs: Install curbs at locations indicated on Drawings. Set roof curb so top surface of roof curb is level. Install flashing around bases where they meet sheet metal roofing.

E. Bar-Type Snow Guards: Attach bar supports to vertical ribs of standing-seam sheet metal roofing with clamps or setscrews. Do not use fasteners that will penetrate sheet metal roofing.

F. General: Install sheet metal roof drainage items to produce complete roof drainage system according to SMACNA recommendations and as indicated. Coordinate installation of roof perimeter flashing with installation of roof drainage system.

G. Hanging Gutters: Join sections with riveted and soldered joints or with lapped joints sealed with sealant. Provide for thermal expansion. Attach gutters at eave or fascia to firmly anchored gutter brackets or straps spaced not more than 36 inches apart. Provide end closures and seal watertight with sealant. Slope to downspouts.

1. Fasten gutter spacers to front and back of gutter.
2. Loosely lock straps to front gutter bead and anchor to roof deck.
3. Anchor and loosely lock back edge of gutter to continuous cleat.
4. Anchor back of gutter that extends onto roof deck with cleats spaced not more than 24 inches apart.
5. Anchor gutter with spikes and ferrules spaced not more than 24 inches apart.
6. Install gutter with expansion joints at locations indicated, but not exceeding, 50 feet apart. Install expansion-joint caps.
7. Provide flood testing of gutters to assure watertightness.

H. Splash Blocks: Install where downspouts discharge onto low-slope roofs and where indicated. Set in cement or sealant compatible with roofing membrane.

3.7 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal roofing within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.8 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

1. Steel and Aluminum Materials: Clean off excess sealants.
2. Copper Materials: Clean and neutralize flux materials. Clean off excess solder and sealants.

B. Remove temporary protective coverings and strippable films, if any, as sheet metal roofing is installed. On completion of sheet metal roofing installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain in a clean condition during construction.

C. Replace panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Sheet metal flashing and trim for the following applications:
   a. Through-wall flashing.
   b. Formed wall flashing and trim.
   c. Formed low-slope roof flashing and trim.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 04 20 00 - UNIT MASONRY for installation of through-wall flashings.
2. Section 06 10 00 - ROUGH CARPENTRY for wood nailers, curbs, and blocking.
3. Section 07 27 00 - AIR BARRIERS for perimeter terminations at air and vapor barrier assembly.
4. Section 07 42 00 - METAL WALL PANELS for factory-formed metal wall panels and flashing and trim not part of sheet metal flashing and trim.
5. Section 07 54 00 - THERMOPLASTIC MEMBRANE ROOFING for installing sheet metal flashing and trim integral with roofing membrane.
6. Section 07 92 00 - JOINT SEALANTS for field-applied sheet metal flashing and trim sealants.
7. Section 07 95 00 - EXPANSION CONTROL for manufactured sheet metal expansion-joint covers.

1.3 PERFORMANCE REQUIREMENTS

A. General: Install sheet metal flashing and trim to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing, rattling, leaking, and fastener disengagement.

B. Fabricate and install roof edge flashing and copings capable of resisting Wind Zone forces required by Code according to recommendations in FMG Loss Prevention Data Sheet 1-49.

C. Thermal Movements: Provide sheet metal flashing and trim that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of sheet metal and trim thermal movements. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F material surfaces.

D. Water Infiltration: Provide sheet metal flashing and trim that do not allow water infiltration to building interior.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.
3. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.

C. Shop Drawings: Show layouts of sheet metal flashing and trim, including plans and elevations. Distinguish between shop- and field-assembled work. Include the following:

1. Identify material, thickness, weight, and finish for each item and location in Project.
2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
3. Details for fastening, joining, supporting, and anchoring sheet metal flashing and trim, including fasteners, clips, cleats, and attachments to adjoining work.
4. Details of expansion-joint covers, including showing direction of expansion and contraction.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:

1. Sheet Metal Flashing: 12 inches long. Include fasteners, cleats, clips, closures, and other attachments.
2. Trim: 12 inches long. Include fasteners and other exposed accessories.
3. Accessories: Full-size Sample.

1.5 QUALITY ASSURANCE

A. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual." Conform to dimensions and profiles shown unless more stringent requirements are indicated.

B. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1. Meet with the Owner, Architect and Owner's insurer if applicable, Installer, and installers whose work interfaces with or affects sheet metal flashing and trim including installers of roofing materials, roof accessories, unit skylights, and roof-mounted equipment.
2. Review methods and procedures related to sheet metal flashing and trim.
3. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
4. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver sheet metal flashing materials and fabrications undamaged. Protect sheet metal flashing and trim materials and fabrications during transportation and handling.

B. Unload, store, and install sheet metal flashing materials and fabrications in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack materials on platforms or pallets, covered with suitable weathertight and ventilated covering. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.

1.7 COORDINATION

A. Coordinate installation of sheet metal flashing and trim with interfacing and adjoining construction to provide a leakproof, secure, and noncorrosive installation.

PART 2 - PRODUCTS

2.1 SHEET METALS

A. Galvalume Metallic-Coated Steel Sheet, Prepainted with Coil Coating: Provide aluminum-zinc alloy-coated steel sheet according to ASTM A 792/A 792M, Class AZ50 coating designation, Grade 40 with smooth, flat surface; prepainted by coil-coating process to comply with ASTM A 755/A 755M.

B. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, with No. 2D dull, cold rolled finish. Thickness as specified in this Section.

2.2 UNDERLAYMENT MATERIALS

A. Felts: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.

B. Slip Sheet: Rosin-sized paper, minimum 3 lb/100 sq. ft..

2.3 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads.

1. Exposed Fasteners: Heads matching color of sheet metal by means of plastic caps or factory-applied coating.
2. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws, gasketed, with hex washer head.
3. Blind Fasteners: High-strength aluminum or stainless-steel rivets.

C. Solder for Stainless Steel: ASTM B 32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.

D. Sealing Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape.

E. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

F. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.

G. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

H. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.4 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated. Shop fabricate items where practicable. Obtain field measurements for accurate fit before shop fabrication.

B. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.

C. Fabricate sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.

1. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.

2. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.

D. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA recommendations.

E. Expansion Provisions: Where lapped or bayonet-type expansion provisions in the Work cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with elastomeric sealant concealed within joints.

F. Conceal fasteners and expansion provisions where possible on exposed-to-view sheet metal flashing and trim, unless otherwise indicated.

G. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

1. Thickness: As recommended by SMACNA's "Architectural Sheet Metal Manual" for application but not less than thickness of metal being secured.

2.5 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Roof Edge Flashing (Gravel Stop) and Fascia Caps: Fabricate in minimum 96-inch-long, but not exceeding 10-foot- long, sections. Furnish with 6-inch-wide joint cover plates.

1. Joint Style: Butt, with 12-inch-wide concealed backup plate.
2. Fabricate from the following material:
   a. Galvalume: 0.050 inch (1.27 mm) thick.

B. Copings: Fabricate in minimum 96-inch-long, but not exceeding 10-foot-long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners, seal, and solder or weld watertight.

1. Joint Style: Butt, with 12-inch-wide concealed backup plate.
2. Fabricate copings from the following material:
   a. Galvalume: 0.050 inch (1.27 mm) thick.

C. Roof and Roof to Wall Transition Expansion-Joint Cover: Fabricate from the following material:
1. Stainless Steel: 0.025 inch (0.64 mm) thick.

D. Base Flashing: Fabricate from the following material:
1. Stainless Steel: 0.019 inch (0.48 mm) thick.

E. Counterflashing: Fabricate from the following material:
1. Stainless Steel: 0.019 inch (0.48 mm) thick.

F. Roof-Penetration Flashing: Fabricate from the following material:
1. Stainless Steel: [0.019 inch (0.48 mm) thick.

G. Roof-Drain Flashing: Fabricate from the following material:
1. Stainless Steel: 0.016 inch (0.40 mm) thick.

H. Splash Pans: Fabricate from the following material:
   1. Stainless Steel: 0.0187 inch thick.

2.6 WALL SHEET METAL FABRICATIONS

A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch-long, but not exceeding 12 foot long, sections, under copings, at shelf angles, and where indicated. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches beyond each side of wall openings. Form with 2-inch-high end dams. Fabricate from the following material:
   1. Stainless Steel: 0.016 inch (0.40 mm) thick.

B. Through-Wall Flashing: Outside and inside corners shall be shop fabricated with fully soldered joints, corner legs to be a minimum 6 in. Hem exposed edges. Refer to Drawings for details.

2.7 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of work.

   1. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
   2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

   1. Torch cutting of sheet metal flashing and trim is not permitted.

B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by fabricator or manufacturers of dissimilar metals.

1. Coat side of stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip-sheet or install a course of polyethylene underlayment.
3. Bed flanges in thick coat of asphalt roofing cement where required for waterproof performance.

C. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.

D. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and elastomeric sealant.

E. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.

1. Space cleats not more than 12 inches apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.

F. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with elastomeric sealant concealed within joints.

G. Fasteners: Use fasteners of sizes that will penetrate substrate not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.

1. Galvalume: Use aluminum or stainless steel fasteners.
2. Stainless Steel: Use stainless-steel fasteners.

H. Seal joints with elastomeric sealant as required for watertight construction.

1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70 deg F set joint members for 50 percent movement either way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.
2. Prepare joints and apply sealants to comply with requirements in Section 07 92 00 - JOINT SEALANTS.

I. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pretin edges of sheets to be soldered to a width of 1-1/2 inches except where pretinned surface would show in finished Work.

1. Do not solder aluminum sheet.
2. Stainless-Steel Soldering: Pretin edges of uncoated sheets to be soldered using solder recommended for stainless steel and phosphoric acid flux. Promptly wash off acid flux residue from metal after soldering.

3. Do not use open-flame torches for soldering. Heat surfaces to receive solder and flow solder into joints. Fill joints completely. Completely remove flux and spatter from exposed surfaces.

J. Aluminum Flashing: Rivet or weld joints in uncoated aluminum where necessary for strength.

3.3 ROOF FLASHING INSTALLATION

A. General: Install sheet metal roof flashing and trim to comply with performance requirements[, sheet metal manufacturer's written installation instructions,] and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight.

B. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending a minimum of 4 inches (100 mm) over base flashing. Install stainless steel draw band and tighten.

C. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints a minimum of 4 inches and bed with elastomeric sealant.

1. Secure in a waterproof manner by means of snap-in installation and sealant.

D. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Install flashing as follows:
1. Seal with elastomeric sealant and clamp flashing to pipes penetrating roof except for flashing on vent piping.

3.4 WALL FLASHING INSTALLATION

A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

B. Through-Wall Flashing: Installation of through-wall flashing is specified in Section 04 20 00 - UNIT MASONRY.

3.5 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder and sealants.

C. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain in a clean condition during construction.

D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 62 00

SECTION 077200

ROOF ACCESSORIES

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Roof hatches.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 018110, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 055000 - METAL FABRICATIONS for metal vertical ladders, ships' ladders, and stairs for access to roof hatches, and from roof to roof.
2. Section 061000 - ROUGH CARPENTRY for wood cants and wood nailers
3. Section 076200 - SHEET METAL FLASHING AND TRIM for shop- and field-fabricated metal flashing and counterflashing, roof expansion-joint covers, and miscellaneous sheet metal trim and accessories.
4. Division 23 - HEATING, VENTILATING, AND AIR CONDITIONING for roof-mounted ventilators.
5. Division 26 - ELECTRICAL for power supply and final connections for automatically operated heat and smoke vents.

1.3 SUBMITTALS

A. Product Data: For each type of roof accessory indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of

material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.

3. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.

C. Shop Drawings: Show fabrication and installation details for roof accessories. Show layouts of roof accessories including plans and elevations. Indicate dimensions, weights, loadings, required clearances, method of field assembly, and components. Include plans, elevations, sections, details, and attachments to other work.

1.4 QUALITY ASSURANCE

A. Sheet Metal Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" details for fabrication of units, including flanges and cap flashing to coordinate with type of roofing indicated.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Pack, handle, and ship roof accessories properly labeled in heavy-duty packaging to prevent damage.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify required openings for each type of roof accessory by field measurements before fabrication and indicate measurements on Shop Drawings.

1.7 COORDINATION

A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.

PART 2 - PRODUCTS

2.1 ROOF HATCHES

A. Roof Hatches: Fabricate roof hatches with insulated double-wall lids and insulated double-wall curb frame with integral deck mounting flange and lid frame counterflashing. Fabricate with welded or mechanically fastened and sealed corner joints. Provide continuous weathertight perimeter gasketing and equip with corrosion-resistant or hot-dip galvanized hardware.

1. Available Manufacturers:

a. Babcock-Davis; a Cierra Products Inc. Company.
b. Bilco Company (The).
c. Nystrom, Inc.
d. O'Keeffe's Inc.
e. Wasco Products, Inc.

2. Loads: Fabricate roof hatches to withstand 40-lbf/sq. ft. external and 20-lbf/sq. ft. internal loads.
3. Type and Size: Lid type and size as indicated on Drawings.
4. Curb and Lid Material: Galvanized steel sheet, 0.079 inch thick.
5. Insulation: Manufacturer's standard board insulation.
6. Interior Lid Liner: Manufacturer's standard metal liner of same material and finish as outer metal lid.
7. Exterior Curb Liner: Manufacturer's standard metal liner of same material and finish as metal curb.
8. Fabricate units to minimum height of 12 inches unless otherwise indicated.
9. Hardware: Galvanized steel spring latch with turn handles, butt- or pintle-type hinge system, and padlock hasps inside and outside.
10. Ladder Safety Post: Manufacturer's standard ladder safety post. Post to lock in place on full extension. Provide release mechanism to return post to closed position.

2.2 MISCELLANEOUS MATERIALS

A. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, complying with AWPA C2; not less than 1-1/2 inches thick.

B. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

C. Fasteners: Same metal as metals being fastened, or nonmagnetic stainless steel or other noncorrosive metal as recommended by roof accessory manufacturer. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners.

D. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, or PVC; or flat design of foam rubber, sponge neoprene, or cork.

E. Elastomeric Sealant: ASTM C 920, polyurethane sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of work.

1. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored and is ready to receive roof accessories.
2. Verify dimensions of roof openings for roof accessories.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install roof accessories according to manufacturer's written instructions. Anchor roof accessories securely in place and capable of resisting forces specified. Use fasteners,

separators, sealants, and other miscellaneous items as required for completing roof accessory installation. Install roof accessories to resist exposure to weather without failing, rattling, leaking, and fastener disengagement.

B. Install roof accessories to fit substrates and to result in watertight performance.

C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

1. Coat concealed side of uncoated aluminum roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing exposed-to-view components of roof accessories directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip-sheet, or install a course of polyethylene underlayment.
3. Bed flanges in thick coat of asphalt roofing cement where required by roof accessory manufacturers for waterproof performance.

D. Install roof accessories level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil canning, buckling, or tool marks.

E. Roof Hatch Installation:

1. Check roof hatch for proper operation. Adjust operating mechanism as required. Clean and lubricate joints and hardware.
2. Attach ladder safety post according to manufacturer's written instructions.

F. Seal joints with elastomeric sealant as required by manufacturer of roof accessories.

3.3 TOUCH UP

A. Touch up factory-primed surfaces with compatible primer ready for field painting in accordance with Section 099000 - PAINTING AND COATING.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

3.4 CLEANING

A. Clean exposed surfaces according to manufacturer's written instructions.

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Concealed sprayed fire-resistive materials.
2. Exposed sprayed fire-resistive materials.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 03 30 00 - CAST-IN-PLACE CONCRETE for concrete protecting structural steel.
2. Section 04 20 00 - UNIT MASONRY for masonry protecting structural steel.
3. Section 05 12 00 - STRUCTURAL STEEL FRAMING for surface conditions required for structural steel receiving sprayed fire-resistive materials.
4. Section 07 21 00 - THERMAL INSULATION for fire-safing insulation.
5. Section 07 84 10 - PENETRATION FIRESTOPPING for firestopping and firesafing insulation.
6. Section 09 21 10 - GYPSUM BOARD ASSEMBLIES for fire-resistance-rated assemblies.
7. Section 09 21 20 - GYPSUM BOARD SHAFT-WALL ASSEMBLIES for fire-resistance-rated assemblies.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.

3. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.

C. Shop Drawings: Structural framing plans indicating the following:

1. Locations and types of surface preparations required before applying sprayed fire-resistive material.
2. Extent of sprayed fire-resistive material for each construction and fire-resistance rating, including the following:

   a. Applicable fire-resistance design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.
   b. Minimum thicknesses needed to achieve required fire-resistance ratings of structural components and assemblies.

3. Treatment of sprayed fire-resistive material after application.

D. Samples for Verification: For each type of colored, exposed sprayed fire-resistive material, two Samples, each 4 inches square, of each color, texture, and material formulation to be applied. Where finishes involve normal color and texture variations, include Sample sets showing the full range of variations expected.

E. Qualification Data: For Installer, manufacturer, and testing agency.

F. Compatibility and Adhesion Test Reports: From sprayed fire-resistive material manufacturer indicating the following:

1. Materials have been tested for bond with substrates.
2. Materials have been verified by sprayed fire-resistive material manufacturer to be compatible with substrate primers and coatings.
3. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for proposed sprayed fire-resistive materials.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by sprayed fire-resistive material manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements. A manufacturer's willingness to sell its sprayed fire-resistive materials to Contractor or to an installer engaged by Contractor does not in itself confer qualification on the buyer.

B. Testing Agency Qualifications: An independent approved testing agency, acceptable to authorities having jurisdiction, with the experience and capability to conduct the testing indicated, as documented in accordance with local State Building Code.

C. Source Limitations: Obtain sprayed fire-resistive materials through one source from a single manufacturer.

D. Sprayed Fire-Resistive Materials Testing: By an approved testing and inspecting agency engaged by Contractor or manufacturer to test for compliance with specified requirements for performance and test methods.

1. Sprayed fire-resistive materials are randomly selected for testing from bags bearing the applicable classification marking of UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
2. Testing is performed on specimens of sprayed fire-resistive materials that comply with laboratory testing requirements specified in Part 2 and are otherwise identical to installed fire-resistive materials, including application of accelerant, sealers, topcoats, tamping, troweling, rolling, and water overspray, if any of these are used in final application.
3. Testing is performed on specimens whose application the independent testing and inspecting agency witnessed during preparation and conditioning. Include in test reports a full description of preparation and conditioning of laboratory test specimens.

E. Compatibility and Adhesion Testing: Engage a qualified testing and inspecting agency to test for compliance with requirements for specified performance and test methods.

1. Test for bond per ASTM E 736 and requirements in UL's "Fire Resistance Directory" for coating materials. Provide bond strength indicated in referenced fire-resistance design, but not less than minimum specified in Part 2.
2. Verify that manufacturer, through its own laboratory testing or field experience, has not found primers or coatings to be incompatible with sprayed fire-resistive material.

F. Fire-Test-Response Characteristics: Provide sprayed fire-resistive materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify bags containing sprayed fire-resistive materials with appropriate markings of applicable testing and inspecting agency.

1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency acceptable to authorities having jurisdiction, for sprayed fire-resistive material serving as direct-applied protection tested per ASTM E 119.
2. Surface-Burning Characteristics: ASTM E 84, limits in accordance with local State Building Code.

G. Provide products containing no detectable asbestos as determined according to the method specified in 40 CFR 763, Subpart E, Appendix E, Section 1, "Polarized Light Microscopy."

H. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01. Review methods and procedures related to sprayed fire-resistive materials including, but not limited to, the following:

1. Review and finalize construction schedule and verify sequencing and coordination requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to Project site in original, unopened packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, shelf life if applicable, and fire-resistance ratings applicable to Project.

B. Use materials with limited shelf life within period indicated. Remove from Project site and discard materials whose shelf life has expired.

C. Store materials inside, under cover, aboveground, and kept dry until ready for use. Remove from Project site and discard wet or deteriorated materials.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not apply sprayed fire-resistive material when ambient or substrate temperature is 40 deg F or lower unless temporary protection and heat is provided to maintain temperature at or above this level for 24 hours before, during, and for 24 hours after product application.

B. Ventilation: Ventilate building spaces during and after application of sprayed fire-resistive material. Use natural means or, if they are inadequate, forced-air circulation until fire-resistive material dries thoroughly. Comply with manufacturer's recommended ventilation procedures.

1.7 COORDINATION

A. Sequence and coordinate application of sprayed fire-resistive materials with other related work specified in other Sections to comply with the following requirements:

1. Provide temporary enclosure as required to confine spraying operations and protect the environment.
2. Provide temporary enclosures for applications to prevent deterioration of fire-resistive material due to exposure to weather and to unfavorable ambient conditions for humidity, temperature, and ventilation.
3. Avoid unnecessary exposure of fire-resistive material to abrasion and other damage likely to occur during construction operations subsequent to its application.
4. Do not apply fire-resistive material to metal roof deck substrates until concrete topping, if any, has been completed. For metal roof decks without concrete topping, do not apply fire-resistive material to metal roof deck substrates until roofing has been completed; prohibit roof traffic during application and drying of fire-resistive material.
5. Do not apply fire-resistive material to metal floor deck substrates until concrete topping has been completed.
6. Except for thin-film intumescent fireproofing, do not begin applying fire-resistive material until clips, hangers, supports, sleeves, and other items penetrating fire protection are in place.
7. Defer installing ducts, piping, and other items that would interfere with applying fire-resistive material until application of fire protection is completed.
8. Do not install enclosing or concealing construction until after fire-resistive material has been applied, inspected, and tested and corrections have been made to defective applications.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form, signed by Contractor and by Installer, in which manufacturer agrees to repair or replace sprayed fire-resistive materials that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, the following:

1. Cracking, flaking, spalling, or eroding in excess of specified requirements; peeling; or delaminating of sprayed fire-resistive materials from substrates.
2. Not covered under the warranty are failures due to damage by occupants and the Owner's maintenance personnel, exposure to environmental conditions other than those investigated and approved during fire-response testing, and other causes not reasonably foreseeable under conditions of normal use.

B. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CONCEALED SPRAYED FIRE-RESISTIVE MATERIALS

A. General: For concealed applications of sprayed fire-resistive materials, provide manufacturer's standard products complying with requirements indicated for material composition and physical properties representative of installed products.

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cementitious Sprayed Fire-Resistive Material:

a. Carboline Company, subsidiary of RPM International, Fireproofing Products Div.; Pyrolite 15.
b. Carboline Company, subsidiary of RPM International, Fireproofing Products Div.; AD Southwest Fireproofing Type 5GP.
c. Grace, W. R. & Co.--Conn., Construction Products Div.; Monokote Type MK-6/HY.
d. Isolatek International, Cafco Products; Cafco 300.
e. Southwest Fireproofing Products Co., Inc.; 5EF.

C. Material Composition: Cementitious sprayed fire-resistive material consisting of factory-mixed, dry formulation of gypsum or portland cement binders and lightweight mineral or synthetic aggregates mixed with water at Project site to form a slurry or mortar for conveyance and application, per ASTM E 1513.

D. Physical Properties: Minimum values, unless otherwise indicated, or higher values required to attain designated fire-resistance ratings, measured per standard test methods referenced with each property as follows:

1. Dry Density: 15 lb/cu. ft. for average and individual densities regardless of density indicated in referenced fire-resistance design, or greater if required to attain fire-resistance ratings indicated, per ASTM E 605 or AWCI Technical Manual 12-A, Section 5.4.5, "Displacement Method."
2. Thickness: Provide minimum average thickness required for fire-resistance design indicated according to the following criteria, but not less than 0.375 inch, per ASTM E 605:

a. Where the referenced fire-resistance design lists a thickness of 1 inch or greater, the minimum allowable individual thickness of sprayed fire-resistive material is the design thickness minus 0.25 inch.

b. Where the referenced fire-resistance design lists a thickness of less than 1 inch but more than 0.375 inch, the minimum allowable individual thickness of sprayed fire-resistive material is the greater of 0.375 inch or 75 percent of the design thickness.
c. No reduction in average thickness is permitted for those fire-resistance designs whose fire-resistance ratings were established at densities of less than 15 lb/cu. ft..

3. Bond Strength: 150 lbf/sq. ft. minimum per ASTM E 736 under the following conditions:

a. Field test sprayed fire-resistive material that is applied to flanges of wide-flange, structural-steel members on surfaces matching those that will exist for remainder of steel receiving fire-resistive material.
b. If surfaces of structural steel receiving sprayed fire-resistive material are primed or otherwise painted for coating materials, perform series of bond tests specified in UL's "Fire Resistance Directory." Provide bond strength indicated in referenced UL fire-resistance criteria, but not less than 150 lbf/sq. ft. minimum per ASTM E 736.
c. Minimum thickness of sprayed fire-resistive material tested in laboratory shall be 0.75 inch.

4. Compressive Strength: 5.21 lbf/sq. in. as determined in the laboratory per ASTM E 761. Minimum thickness of sprayed fire-resistive material tested shall be 0.75 inch and minimum dry density shall be as specified, but not less than 15 lb/cu. ft.
5. Corrosion Resistance: No evidence of corrosion per ASTM E 937.
6. Deflection: No cracking, spalling, or delamination per ASTM E 759.
7. Effect of Impact on Bonding: No cracking, spalling, or delamination per ASTM E 760.
8. Air Erosion: Maximum weight loss of 0.025 g/sq. ft. in 24 hours per ASTM E 859. For laboratory tests, minimum thickness of sprayed fire-resistive material is 0.75 inch maximum dry density is 15 lb/cu. ft. test specimens are not prepurged by mechanically induced air velocities, and tests are terminated after 24 hours.
9. Fungal Resistance: No observed growth on specimens per ASTM G 21.

2.2 SEMI-EXPOSED CEMENTITIOUS SPRAYED FIRE-RESISTIVE MATERIALS

A. General: For exposed applications with high potential for physical damage or exposure to moisture or high humidity for sprayed fire-resistive materials, provide manufacturer's standard products complying with requirements indicated for material composition and for minimum physical properties of each product listed, measured by standard test methods referenced with each property.

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Semi-Exposed Cementitious Sprayed Fire-Resistive Material:

a. Carboline Company, subsidiary of RPM International, Fireproofing Products Div.; Pyrocrete 239.
b. Carboline Company, subsidiary of RPM International, Fireproofing Products Div.; AD Southwest Fireproofing Type 7GP.
c. Grace, W. R. & Co.--Conn., Construction Products Div.; Monokote Type Z106.
d. Isolatek International Corp., Cafco Products.; Cafco 400.
e. Pyrok, Inc.; Pyrok-MD.
f. Southwest Fireproofing Products Co.; 7GP.

2.3 EXPOSED CEMENTITIOUS SPRAYED FIRE-RESISTIVE MATERIALS

A. General: For exposed applications subject to physical abuse or exposure to moisture or high humidity for sprayed fire-resistive materials, provide manufacturer's standard products complying with requirements indicated for material composition and for minimum physical properties of each product listed, measured by standard test methods referenced with each property.

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Exposed Cementitious Sprayed Fire-Resistive Material:

a. Carboline Company, subsidiary of RPM International, Fireproofing Products Div.; Pyrocrete 40.
b. Carboline Company, subsidiary of RPM International, Fireproofing Products Div.; AD Southwest Fireproofing Type 7HD.
c. Grace, W. R. & Co.--Conn., Construction Products Div.; Monokote Type Z146.
d. Isolatek International Corp., Cafco Products.; Fendolite MII.
e. Pyrok, Inc.; Pyrok-HD.
f. Southwest Fireproofing Products Co.; 7HD.

2.4 EXPOSED INTUMESCENT MASTIC FIRE-RESISTIVE COATINGS

A. Exposed Intumescent Mastic Fire-Resistive Materials:

1. Conditioned Interior Space Conditions: Coatings limited to interior climate controlled spaces having no exposure to condensation, and where the relative humidity and temperature are controlled according to the manufacturers recommendations or to not more than 75 percent, which ever is less, during the application and curing of the coating, the construction and the occupancy of the building.

a. Carboline Co., subsidiary of PRM International, Fireproofing Products Div.; Nullifire S607 and Nullifire S606 without topcoat.
b. NuChem Inc.: Thermo-Sorb without topcoat.

2. Interior General Use Conditions: Coatings limited to interior service where protection of the coating during application and curing, the construction and the occupancy of the building are as recommended by the product manufacturer for the specific application.

a. A/D Fire Protection Systems Inc.; Firefilm III and Colorcoat.
b. Albi Manufacturing, Division of StanChem Inc.; Albi Clad TF.
c. Carboline Company, a subsidiary of RPM International, Fireproofing Products Div.; Nullifire S607 or Nullifire S606 and Topseal.
d. Isolatek International Corp., Cafco Products; Cafco SprayFilm-WB 2 or WB-3 Basecoat and Topseal.
e. NuChem Inc.; Thermo-Sorb with topcoat.

3. Exterior Use Conditions: Coatings for exterior use or interior use where exterior environmental conditions exist.

a. Albi Manufacturing, Division of StanChem Inc.; Albi Clad 800.

b. Carboline Co, a subsidiary of RPM International, Fireproofing Products Div.; Nullifire S607 and Topseal.
c. Isolatek International Corp., Cafco Products; Cafco SprayFilm-WB 4 with Topseal.
d. International Paint, LLC; Interchar 212 with topcoat.
e. NuChem Inc.; Thermo-Lag 3000 with topcoat.

B. Thin-Film Fire-Resistive Intumescent Mastic Coating: Factory-mixed formulation.

1. Approved by manufacturer and authorities having jurisdiction for interior or exterior use.
2. Multicomponent system consisting of primer, intumescent base coat and topcoat.
3. Systems shall comply with applicable VOC requirements and meet OTC emission regulations.

C. Color and Gloss: As indicated by manufacturer's designations.

2.5 AUXILIARY FIRE-RESISTIVE MATERIALS

A. General: Provide auxiliary fire-resistive materials that are compatible with sprayed fire-resistive materials and substrates and are approved by UL or another testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistance designs indicated.

B. Substrate Primers: For use on each substrate and with each sprayed fire-resistive product, provide primer that complies with one or more of the following requirements:

1. Primer's bond strength complies with requirements specified in UL's "Fire Resistance Directory," for coating materials based on a series of bond tests per ASTM E 736.
2. Primer is identical to those used in assemblies tested for fire-test-response characteristics of sprayed fire-resistive material per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

C. Adhesive for Bonding Fire-Resistive Material: Product approved by manufacturer of sprayed fire-resistive material.

D. Metal Lath: Expanded metal lath fabricated from material of weight, configuration, and finish required to comply with fire-resistance designs indicated and fire-resistive material manufacturer's written recommendations. Include clips, lathing accessories, corner beads, and other anchorage devices required to attach lath to substrates and to receive sprayed fire-resistive material.

E. Reinforcing Fabric: Glass-fiber fabric of type, weight, and form required to comply with fire-resistance designs indicated, approved by manufacturer of intumescent mastic coating fire-resistive material.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrates and other conditions affecting performance of work. A substrate is in satisfactory condition if it complies with the following:

1. Substrates comply with requirements in the Section where the substrate and related materials and construction are specified.
2. Substrates are free of dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, incompatible primers, incompatible paints, incompatible encapsulants, or other foreign substances capable of impairing bond of fire-resistive materials with substrates under conditions of normal use or fire exposure.
3. Objects penetrating fire-resistive material, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
4. Substrates are not obstructed by ducts, piping, equipment, and other suspended construction that will interfere with applying fire-resistive material.

B. Verify that concrete work on steel deck has been completed.

C. Verify that roof construction, installation of rooftop HVAC equipment, and other related work are completed.

D. Conduct tests according to fire-resistive material manufacturer's written recommendations to verify that substrates are free of substances capable of interfering with bond.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Cover other work subject to damage from fallout or overspray of fire-resistive materials during application.

B. Clean substrates of substances that could impair bond of fire-resistive material, including dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, and incompatible primers, paints, and encapsulants.

C. For exposed applications, repair substrates to remove surface imperfections that could affect uniformity of texture and thickness in finished surface of sprayed fire-resistive material. Remove minor projections and fill voids that would telegraph through fire-resistive products after application.

3.3 APPLICATION, GENERAL

A. Comply with fire-resistive material manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and spray on fire-resistive material, as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.

B. Apply sprayed fire-resistive material that is identical to products tested as specified in Part 1 "Quality Assurance" Article and substantiated by test reports, with respect to rate of application, accelerator use, sealers, topcoats, tamping, troweling, water overspray, or other materials and procedures affecting test results.

C. Install metal lath and reinforcing fabric, as required, to comply with fire-resistance ratings and fire-resistive material manufacturer's written recommendations for conditions of exposure and intended use. Securely attach lath and fabric to substrate in position required for support and reinforcement of fire-resistive material. Use anchorage devices of type recommended in writing

by sprayed fire-resistive material manufacturer. Attach accessories where indicated or required for secure attachment of lath and fabric to substrate.

D. Coat substrates with bonding adhesive before applying fire-resistive material where required to achieve fire-resistance rating or as recommended in writing by sprayed fire-resistive material manufacturer for material and application indicated.

E. Extend fire-resistive material in full thickness over entire area of each substrate to be protected. Unless otherwise recommended in writing by sprayed fire-resistive material manufacturer, install body of fire-resistive covering in a single course.

F. Spray apply fire-resistive materials to maximum extent possible. Following the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by sprayed fire-resistive material manufacturer.

G. Where sealers are used, apply products that are tinted to differentiate them from sprayed fire-resistive material over which they are applied.

3.4 APPLICATION, CONCEALED SPRAYED FIRE-RESISTIVE MATERIALS

A. Apply concealed sprayed fire-resistive material in thicknesses and densities not less than those required to achieve fire-resistance ratings designated for each condition.

B. Cure concealed sprayed fire-resistive material according to product manufacturer's written recommendations.

3.5 APPLICATION, EXPOSED SPRAYED FIRE-RESISTIVE MATERIALS

A. Apply exposed sprayed fire-resistive material in thicknesses and densities not less than those required to achieve fire-resistance ratings designated for each condition, but apply in greater thicknesses and densities if indicated.

B. Provide a uniform finish complying with description indicated for each type of material and matching Architect's sample or, if none, finish approved for field-erected mockup.

C. Apply exposed cementitious sprayed fire-resistive materials to produce the following finish:

1. Even, spray-textured finish, produced by rolling flat surfaces of fire-protected members with a damp paint roller to remove drippings and excessive roughness.

D. Cure exposed sprayed fire-resistive material according to product manufacturer's written recommendations.

3.6 APPLICATION, EXPOSED INTUMESCENT MASTIC FIRE-RESISTIVE COATINGS

A. Apply exposed intumescent mastic fire-resistive coatings in thicknesses and densities not less than those required to achieve fire-resistance ratings designated for each condition.

B. Apply intumescent mastic fire-resistive coating as follows:

1. Install reinforcing fabric as required to obtain designated fire-resistance rating and where indicated.

2. Finish: Even, spray-textured finish produced by lightly rolling flat surfaces of fire-protected members before fire-resistive material dries, to smooth out surface irregularities and to seal in surface fibers.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.

1. Testing and inspecting agency will interpret tests and state in each report whether tested work complies with or deviates from requirements.

B. Tests and Inspections: Testing and inspecting of completed applications of sprayed fire-resistive material shall take place in successive stages, in areas of extent and using methods as follows. Do not proceed with application of sprayed fire-resistive material for the next area until test results for previously completed applications of sprayed fire-resistive material show compliance with requirements. Tested values must equal or exceed values indicated and required for approved fire-resistance design.

1. Thickness for Floor, Roof, and Wall Assemblies: For each 1000-sq. ft. area, or partial area, on each floor, from the average of 4 measurements from a 144-sq. in. sample area, with sample width of not less than 6 inches per ASTM E 605.
2. Thickness for Structural Frame Members: From a sample of 25 percent of structural members per floor, taking 9 measurements at a single cross section for structural frame beams or girders, 7 measurements of a single cross section for joists and trusses, and 12 measurements of a single cross section for columns per ASTM E 605.
3. Density for Floors, Roofs, Walls, and Structural Frame Members: At frequency and from sample size indicated for determining thickness of each type of construction and structural framing member, per ASTM E 605 or AWCI Technical Manual 12-A, Section 5.4.5, "Displacement Method."
4. Bond Strength for Floors, Roofs, Walls, and Structural Framing Members: For each 10,000-sq. ft. area, or partial area, on each floor, cohesion and adhesion from one sample of size indicated for determining thickness of each type of construction and structural framing member, per ASTM E 736.
   a. Field test sprayed fire-resistive material that is applied to flanges of wide-flange, structural steel members on surfaces matching those that will exist for remainder of steel receiving fire-resistive material.
   b. If surfaces of structural steel receiving sprayed fire-resistive material are primed or otherwise painted for coating materials, perform series of bond tests specified in UL's "Fire Resistance Directory." Provide bond strength indicated in referenced UL fire-resistance criteria, but not less than 150 lbf/sq. ft. minimum per ASTM E 736.
5. If testing finds applications of sprayed fire-resistive material are not in compliance with requirements, testing and inspecting agency will perform additional random testing to determine extent of noncompliance.

C. Remove and replace applications of sprayed fire-resistive material that do not pass tests and inspections for cohesion and adhesion, for density, or for both and retest as specified above.

D. Apply additional sprayed fire-resistive material, per manufacturer's written instructions, where test results indicate that thickness does not comply with specified requirements, and retest as specified above.

E. Field inspect intumescent materials in accordance with AWCI Tech Manual 12B.

3.8 CLEANING, PROTECTING, AND REPAIR

A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.

B. Protect sprayed fire-resistive material, according to advice of product manufacturer and Installer, from damage resulting from construction operations or other causes so fire protection will be without damage or deterioration at time of Substantial Completion.

C. Coordinate application of sprayed fire-resistive material with other construction to minimize need to cut or remove fire protection. As installation of other construction proceeds, inspect sprayed fire-resistive material and patch any damaged or removed areas.

D. Repair or replace work that has not successfully protected steel.

END OF SECTION 07 81 00

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Through-penetration firestop systems for penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and will be performed under the designated Sections:

1. Section 07 84 40 - FIRE-RESISTIVE JOINT SYSTEMS for fire-resistive joint sealers.
2. Section 07 92 00 - JOINT SEALANTS for standard joint sealers.
3. Division 21 - FIRE PROTECTION for fire-suppression piping penetrations.
4. Division 22 - PLUMBING for piping penetrations.
5. Division 23 - HEATING, VENTILATING AND AIR CONDITIONING for duct and piping penetrations.
6. Division 26 - ELECTRICAL for cable and conduit penetrations.

1.3 PERFORMANCE REQUIREMENTS

A. General: For penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.

B. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated, as determined per ASTM E 814.

C. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.

1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.

2. For floor penetrations with annular spaces exceeding 4 inches in width and exposed to possible loading and traffic, provide firestop systems capable of supporting floor loads involved, either by installing floor plates or by other means.
3. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. LEED Submittals:

1. Credit IEQ 4.1: Manufacturers' product data for interior adhesives, sealants and sealant primers, including printed statement of VOC content.

C. Shop Drawings: For each through-penetration firestop system, show each type of construction condition penetrated, relationships to adjoining construction, and type of penetrating item. Include firestop design designation of qualified testing and inspecting agency that evidences compliance with requirements for each condition indicated.

1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each through-penetration firestop system configuration for construction and penetrating items.

D. Through-Penetration Firestop System Schedule: Indicate locations of each through-penetration firestop system, along with the following information:

1. Types of penetrating items.
2. Types of constructions penetrated, including fire-resistance ratings and, where applicable, thicknesses of construction penetrated.
3. Through-penetration firestop systems for each location identified by firestop design designation of qualified testing and inspecting agency.

E. Qualification Data: For Installer.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Either a firm that has been approved by FMG according to FMG 4991, "Approval of Firestop Contractors" or a firm experienced in installing through-penetration firestop systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction of a minimum of five projects with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements.

B. Source Limitations: Obtain through-penetration firestop systems, for each kind of penetration and construction condition indicated, through one source from a single manufacturer.

C. Fire-Test-Response Characteristics: Provide through-penetration firestop systems that comply with the following requirements and those specified in Part 1 "Performance Requirements" Article:

1. Firestopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.
2. Through-penetration firestop systems are identical to those tested per testing standard referenced in "Part 1 Performance Requirements" Article. Provide rated systems complying with the following requirements:

    a. Through-penetration firestop system products bear classification marking of qualified testing and inspecting agency.
    b. Through-penetration firestop systems correspond to those indicated by reference to through-penetration firestop system designations listed in the UL “Fire Resistance Directory.”

D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver through-penetration firestop system products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, lot number, shelf life if applicable, qualified testing and inspecting agency's classification marking applicable to Project, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials for through-penetration firestop systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install through-penetration firestop systems when ambient or substrate temperatures are outside limits permitted by through-penetration firestop system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Ventilate through-penetration firestop systems per manufacturer's written instructions by natural means or, where this is inadequate, forced-air circulation.

1.8 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.

C. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until each installation has been examined building inspector, if required by authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, through-penetration firestop systems that may be incorporated into the Work include, but are not limited to, those systems indicated in the Through-Penetration Firestop System Schedule at the end of Part 3.

1. Hilti, Inc.
2. BioFireshield; RectorSeal Corporation.
3. Specified Technologies, Inc. (STI).
4. 3M; Fire Protection Products Division.

2.2 FIRESTOPPING MATERIALS

A. Compatibility: Provide through-penetration firestop systems that are compatible with one another; with the substrates forming openings; and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.

B. Materials: Provide through-penetration firestop systems containing primary materials and fill materials which are part of the tested assemblies indicated in the Through-Penetration Firestop System Schedule at the end of Part 3. Fill materials are those referred to in directories of referenced testing and inspecting agencies as "fill," "void," or "cavity" materials.

C. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by qualified testing and inspecting agency for firestop systems indicated

2.3 MIXING

A. For those products requiring mixing before application, comply with through-penetration firestop system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of work. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Clean out openings immediately before installing through-penetration firestop systems to comply with firestop system manufacturer's written instructions and with the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of through-penetration firestop systems.
2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration firestop systems. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by through-penetration firestop system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent through-penetration firestop systems from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestop system materials. Remove tape as soon as possible without disturbing firestop system's seal with substrates.

3.3 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

A. General: Install through-penetration firestop systems to comply with Part 1 "Performance Requirements" Article and with firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

C. Install fill materials for firestop systems by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 FIELD QUALITY CONTROL

A. Inspecting Agency: Engage a qualified, independent inspecting agency to inspect through-penetration firestops. Independent inspecting agency shall comply with ASTM E 2174 requirements including those related to qualifications, conducting inspections, and preparing test reports.

B. Where deficiencies are found, repair or replace through-penetration firestop systems so they comply with requirements.

C. Proceed with enclosing through-penetration firestop systems with other construction only after inspection reports are issued and firestop installations comply with requirements.

3.5 CLEANING AND PROTECTING

A. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce systems complying with specified requirements.

3.6 THROUGH-PENETRATION FIRESTOP SYSTEM SCHEDULE

CONCRETE FLOORS		UL-CLASSIFIED SYSTEMS			
TYPE OF PENETRANT	**F-RATING HR**	**HILTI**	**STI**	**3M**	**BIO-FIRE**
CIRCULAR BLANK OPENINGS	1	FA 0006, CAJ 0070	C-AJ-0094, C-AJ-0100	CAJ 0009	CAJ 0056
	2	FA 0006, CAJ 0070	C-AJ-0094, C-AJ-0100	CAJ 0009	CAJ 0056
	3	CAJ 0055	C-AJ-0014	CAJ 0009	CAJ 0056
SINGLE METAL PIPES OR CONDUIT	1	CAJ 1226, CAJ 1278, FA 1017	C-AJ-1080, C-AJ-1240, F-A-1110	CAJ 1058	CAJ 1264
	2	CAJ 1226, CAJ 1278, FA 1017	C-AJ-1080, C-AJ-1240, F-A-1110	CAJ 1058	CAJ 1264
	3	CAJ 1226, CAJ 1278, FA 1017	C-AJ-1080, C-AJ-1240, F-A-1110	CAJ 1058	CAJ 1264
	4	CAJ 8095, CBJ 1034	C-AJ-1217	CAJ 1044	N/A
SINGLE NON-METALLIC PIPE OR CONDUIT (I.E. PVC, CPVC, ABS, ENT)	1	CAJ 2109, CAJ 2168, FA 2054, FA 2067	C-AJ-2297, F-A-2192, F-A-2210	CAJ 2189, CAJ 2117, CAJ 2027	CAJ 2131
	2	CAJ 2109, CAJ 2168, FA 2054, FA 2067	C-AJ-2297, F-A-2192, F-A-2210	CAJ 2189, CAJ 2117	CAJ 2131
	3	CAJ 2109, CAJ 2168, FA 2054,	C-AJ-2297, F-A-2192	CAJ 2005, CAJ 2117	CAJ 2152
	4	N/A*	C-AJ-2364	N/A*	N/A
SINGLE OR BUNDLED CABLES	1	FA 3007, CAJ 3095,	C-AJ-3154, F-A-3021, F-A-3037	CAJ 3021	CAJ 3103
	2	FA 3007, CAJ 3095,	C-AJ-3154, F-A-3021, F-A-3037	CAJ 3021	CAJ 3103
	3	FA 3007, CAJ 3095,	C-AJ-3154, F-A-3021, F-A-3037	CAJ 3030	CAJ 3103
	4	N/A*	C-AJ-3154, C-AJ-3214	N/A*	N/A
CABLE TRAY	1	CAJ 4034, CAJ 4054, CAJ 4017	C-AJ-4029, C-AJ-4088	CAJ 4003	CAJ 4048
	2	CAJ 4034, CAJ 4054, CAJ 4017	C-AJ-4029, C-AJ-4088	CAJ 4003	CAJ 4048
	3	CAJ 4034, CAJ 4017	C-AJ-4029, C-AJ-4060	CAJ 4003	CAJ 4048
	4	N/A*	N/A*	N/A*	N/A

CONCRETE FLOORS (CONTINUED)		UL-CLASSIFIED SYSTEMS			
TYPE OF PENETRANT	F-RATING HR	HILTI	STI	3M	BIO-FIRE
SINGLE INSULATED PIPES	1	FA 5016, FA 5017, CAJ 5090, CAJ 5091,	C-AJ-5079, C-AJ-5087, F-A-5041	CAJ 5080, CAJ 5024, CAJ 5017	CAJ 5082
	2	FA 5016, FA 5017 CAJ 5090, CAJ 5091,	C-AJ-5079, C-AJ-5087, F-A-5041	CAJ 5080, CAJ 5024, CAJ 5017	CAJ 5082
	3	FA5016, CAJ 5061, CAJ 5090,	C-AJ-5079, C-AJ-5029, F-A-5041	CAJ 5024, CAJ 5017	CAJ 5006
	4	CBJ 5006	N/A*	N/A*	N/A
ELECTRICAL BUSWAY	1	CAJ 6006, CAJ 6017	C-AJ-6003, C-AJ-6019	CAJ 6001, CAJ 6002	CAJ 6026
	2	CAJ 6006, CAJ 6017	C-AJ-6003, C-AJ-6019	CAJ 6001, CAJ 6002	CAJ 6026
	3	CAJ 6006, CAJ 6017	C-AJ-6003, C-AJ-6019	CAJ 6001, CAJ 6002	N/A
NON-INSULATED MECHANICAL DUCTWORK WITHOUT DAMPERS	1	CAJ 7046 CAJ 7051	C-AJ-7023, C-AJ-7027	CAJ 7003, CAJ 7021	CAJ 7036
	2	CAJ 7046 CAJ 7051	C-AJ-7023, C-AJ-7027	CAJ 7003, CAJ 7021	N/A
	3	CAJ 7046 CAJ 7051	C-AJ-7023, C-AJ-7027	CAJ 7003, CAJ 7021	N/A
MIXED PENETRANTS	1	CAJ 8056, CAJ 8095, CAJ 8099	C-AJ-8093, C-AJ-8113, C-AJ-8181	CAJ 8001, CAJ 8013	CAJ 8051
	2	CAJ 8056, CAJ 8095, CAJ 8099	C-AJ-8093, C-AJ-8113, C-AJ-8181	CAJ 8001, CAJ 8013	CAJ 8051
	3	CAJ 8056, CAJ 8095, CAJ 8099	C-AJ-8093, C-AJ-8113, C-AJ-8181	CAJ 8001, CAJ 8013	CAJ 8051
	4	CAJ 8095	N/A*	N/A*	N/A

CONCRETE OR BLOCK WALLS		UL-CLASSIFIED SYSTEMS			
TYPE OF PENETRANT	**F-RATING**	**HILTI**	**STI**	**3M**	**BIO-FIRE**
CIRCULAR BLANK OPENINGS	1	CAJ 0055, CAJ 0070	C-AJ-0094, C-AJ-0100	CAJ 0009	CAJ 0056
	2	CAJ 0055, CAJ 0070	C-AJ-0094, C-AJ-0100	CAJ 0009	CAJ 0056
	3	CAJ 0055	C-AJ-0014	CAJ 0009	CAJ 0056
SINGLE METAL PIPES OR CONDUIT	1	CAJ 1226, CAJ 1278,	C-AJ-1080	CAJ 1058	CAJ 1264
	2	CAJ 1226, CAJ 1278,	C-AJ-1080	CAJ 1058	CAJ 1264
	3	CAJ 1226, CAJ 1278,	C-AJ-1080	CAJ 1058	CAJ 1264
	4	CAJ 8095, CBJ 1034, WJ 1042	W-J-1170	CAJ 1044	WJ 1064
SINGLE NON-METALLIC PIPE OR CONDUIT (I.E. PVC, CPVC, ABS, ENT)	1	CAJ 2109, WJ 2108, WJ 2121	W-J-2076, C-AJ-2297	CAJ 2189, CAJ 2117, CAJ 2027	CAJ 2131
	2	CAJ 2109, WJ 2108, WJ 2121	W-J-2076, C-AJ-2297	CAJ 2189, CAJ 2117, CAJ 2027	CAJ2131
	3	CAJ 2109, CAJ 2168, WJ 2091	C-AJ-2297, W-J-2085	CAJ 2005, CAJ 2117, CAJ 2027	CAJ2152
	4	WJ 2091	W-J-2085, W-J-2217	N/A*	N/A
SINGLE OR BUNDLED CABLES	1	CAJ 3095, WJ 3060 WJ 3074	W-J-3090, W-J-3180	CAJ 3021	WJ 3071
	2	CAJ 3095, WJ 3060 WJ 3074	W-J-3090, W-J-3180	CAJ 3021	WJ 3071
	3	CAJ 3095, WJ 3050	C-AJ-3154, C-AJ-3214	CAJ 3030	CAJ 3103
	4	WJ 3050	C-AJ-3154, C-AJ-3214	N/A*	N/A
CABLE TRAY	1	CAJ 4034, CAJ 4054, WJ 4016,	C-AJ-4029, C-AJ-4088	CAJ 4003	CAJ 4048
	2	CAJ 4034, CAJ 4054, WJ 4016,	C-AJ-4029, C-AJ-4088	CAJ 4003	CAJ 4048
	3	CAJ 4034, WJ 8007	C-AJ-4029, W-J-4068	CAJ 4003	CAJ 4048
	4	WJ 8007	W-J-4066, W-J-4068	N/A*	N/A

CONCRETE OR BLOCK WALLS (CONT)		UL-CLASSIFIED SYSTEMS			
TYPE OF PENETRANT	**F-RATING**	**HILTI**	**STI**	**3M**	**BIO-FIRE**
SINGLE INSULATED PIPES	1	CAJ 5090, CAJ 5091, WJ 5042	W-J-5005, W-J-5012	CAJ 5080, CAJ 5024, CAJ 5017	CAJ 5082
	2	CAJ 5090, CAJ 5091, WJ 5042	W-J-5005, W-J-5012	CAJ 5080, CAJ 5024, CAJ 5017	CAJ 5082
	3	CAJ 5090, CAJ 5091,	C-AJ-5079, C-AJ-5029	CAJ 5024, CAJ 5017	CAJ 5006
	4	WJ 5028, CBJ 5006	W-J-5072	N/A*	N/A
ELECTRICAL BUSWAY	1	CAJ 6006, CAJ 6017	C-AJ-6003, C-AJ-6019	CAJ 6001, CAJ 6002	CAJ 6026
	2	CAJ 6006, CAJ 6017	C-AJ-6003, C-AJ-6019	CAJ 6001, CAJ 6002	CAJ 6026
	3	CAJ 6006, CAJ 6017	C-AJ-6003, C-AJ-6019	CAJ 6001, CAJ 6002	N/A
NON-INSULATED MECHANICAL DUCTWORK WITHOUT DAMPERS	1	CAJ 7046, WJ 7029, WJ 7022	W-J-7089, W-J-7005, W-J-7092	CAJ 7003, CAJ 7021	CAJ 7036
	2	CAJ 7046, WJ 7029, WJ 7022	W-J-7089, W-J-7005, W-J-7092	CAJ 7003, CAJ 7021	CAJ 7036
	3	CAJ 7046 CAJ 7051	C-AJ-7023, C-AJ-7027	CAJ 7003, CAJ 7021	N/A
MIXED PENETRANTS	1	CAJ 8096, CAJ 8099 WJ 8007	C-AJ-8093, C-AJ-8113, C-AJ-8181	CAJ 8001, CAJ 8013	CAJ 8051
	2	CAJ 8096, CAJ 8099 WJ 8007	C-AJ-8093, C-AJ-8113, C-AJ-8181	CAJ 8001, CAJ 8013	CAJ 8051
	3	CAJ 8099 WJ 8007	C-AJ-8093, C-AJ-8113, C-AJ-8181	CAJ 8001, CAJ 8013	CAJ 8051
	4	WJ 8007	N/A*	N/A*	N/A

GYPSUM WALLBOARD ASSEMBLIES		UL-CLASSIFIED SYSTEMS			
TYPE OF PENETRANT	**F-RATING**	**HILTI**	**STI**	**3M**	**BIO-FIRE**
METAL PIPES OR CONDUIT	1	WL 1054, WL 1164	W-L-1049	WL 1146	WL 1115
	2	WL 1054, WL 1164	W-L-1049	WL 1010, WL 1146	WL 1115
	4	WL 1110	W-L-1171	WL 1001	
NON-METALLIC PIPE OR CONDUIT	1	WL 2078, WL 2075, WL 2128	W-L-2100, W-L-2048, W-L-2237	WL 2088, WL 2002	WL 2133
	2	WL 2078, WL 2075, WL 2128	W-L-2100, W-L-2048, W-L-2237	WL 2088, WL 2002	WL 2133
	4	WL 2184, WL 2245	W-L-2293, W-L-2507	N/A*	
SINGLE OR BUNDLED CABLES	1	WL 3065	W-L-3210, W-L-3377	WL 3032, WL 3030	WL 3153
	2	WL 3065	W-L-3210, W-L-3377	WL 3032, WL 3030	WL 3153
	4	WL 3139	W-L-3211, W-L-3377	N/A*	
CABLE TRAY	1	WL 4011, WL 4019	W-L-4043, W-L-4079	WL 4004	WL 4032
	2	WL 4011, WL 4019	W-L-4043, W-L-4079	WL 4004	WL 4032
	4	WL 8014	W-L-4076	N/A*	
INSULATED PIPES	1	WL 5029, WL 5096	W-L-5014, W-L-5054, W-L-5091	WL 5040, WL 5001, WL 5032	WL 5062
	2	WL 5029, WL 5096	W-L-5014, W-L-5054, W-L-5091	WL 5040, WL 5001, WL 5032	WL 5062
	4	WL 5073	W-L-5158	N/A*	
NON-INSULATED MECHANICAL DUCTWORK WITHOUT DAMPERS	1	WL 7040, WL 7042	W-L-7026, W-L-7149, W-L-7164	WL 7008	WL 7037
	2	WL 7040, WL 7042	W-L-7026, W-L-7149, W-L-7164	WL 7008, WL 7013, WL 7016	WL 7037
MIXED PENETRANTS	1	WL 8004, WL 8013	W-L-8050, W-L-8073	WL 8010	WL 8017
	2	WL 8004, WL 8013	W-L-8050, W-L-8073	WL 8010, WL 8002	WL 8017
	4	WL 8014	N/A*	N/A*	

* No UL-Classified system is available as of August 2003. Engineer Judgment Drawing Required.

NOTES:

1. Jobsite conditions of each through-penetration firestop system must meet all details of the UL-Classified System selected.
2. If jobsite conditions do not match any UL-classified systems in the schedules above, contact firestop manufacturer for alternative systems or Engineer Judgment Drawings.
3. Coordinate work with other trades to assure that penetration-opening sizes are appropriate for penetrant locations, and vice versa.
4. For 3-hour rated gypsum walls, contact the firestop manufacturer for a UL-classified system or engineer judgment drawing.
5. The Contractor shall verify that the schedule is current at the time of construction, and that each referenced system is suitable for the intended application.

END OF SECTION 07 84 10

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the Work of this Section, including but not limited to fire-resistive joint systems for the following:

1. Floor-to-floor joints.
2. Floor-to-wall joints.
3. Head-of-wall joints.
4. Wall-to-wall joints.
5. Perimeter fire-resistive joint systems consisting of floor-to-wall joints between perimeter edge of fire-resistance-rated floor assemblies and exterior curtain walls.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and will be performed under the designated Sections:

1. Section 07 84 13 - PENETRATION FIRESTOPPING for firestopping.
2. Section 07 92 00 - JOINT SEALANTS for standard joint sealers.
3. Division 21 - FIRE PROTECTION for fire-suppression piping penetrations.
4. Division 22 - PLUMBING for piping penetrations.
5. Division 23 - HEATING, VENTILATING AND AIR CONDITIONING for duct and piping penetrations.
6. Division 26 - ELECTRICAL for cable and conduit penetrations.

1.3 PERFORMANCE REQUIREMENTS

A. General: Provide fire-resistive joint systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assembly in which fire-resistive joint systems are installed.

B. For fire-resistive systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For each fire-resistive joint system, show each kind of construction condition in which joints are installed; also show relationships to adjoining construction. Include fire-resistive joint system design designation of testing and inspecting agency acceptable to authorities having jurisdiction that demonstrates compliance with requirements for each condition indicated.

1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each fire-resistive joint system configuration for construction and penetrating items.

C. Product Certificates: For each type of fire-resistive joint system, signed by product manufacturer.

D. Qualification Data: For Installer.

E. Field quality-control test reports.

F. Research/Evaluation Reports: For each type of fire-resistive joint system.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A firm experienced in installing through-penetration fire stop systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction of a minimum of five projects with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Evidence of FMG 4991 approval is acceptable for installer qualifications, but not mandatory.

B. Installation Responsibility: Assign installation of through-penetration firestop systems and fire-resistive joint systems in Project to a single qualified installer.

C. Source Limitations: Obtain fire-resistive joint systems, for each kind of joint and construction condition indicated, through one source from a single manufacturer.

D. Fire-Test-Response Characteristics: Provide fire-resistive joint systems that comply with the following requirements and those specified in Part 1 "Performance Requirements" Article:

1. Fire-resistance tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL or another agency performing testing and follow-up inspection services for fire-resistive joint systems acceptable to authorities having jurisdiction.
2. Fire-resistive joint systems are identical to those tested per methods indicated in Part 1 "Performance Requirements" Article and comply with the following:

a. Fire-resistive joint system products bear classification marking of qualified testing and inspecting agency.
b. Fire-resistive joint systems correspond to those indicated by referencing system designations of the qualified testing and inspecting agency.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver fire-resistive joint system products to Project site in original, unopened containers or packages with qualified testing and inspecting agency's classification marking applicable to Project and with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, lot number, shelf life, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials for fire-resistive joint systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install fire-resistive joint systems when ambient or substrate temperatures are outside limits permitted by fire-resistive joint system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Ventilate fire-resistive joint systems per manufacturer's written instructions by natural means or, if this is inadequate, forced-air circulation.

1.8 COORDINATION

A. Coordinate construction of joints to ensure that fire-resistive joint systems are installed according to specified requirements.

B. Coordinate sizing of joints to accommodate fire-resistive joint systems.

C. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until each installation has been examined building inspector, if required by authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, fire-resistive joint systems that may be incorporated into the Work include, but are not limited to, those systems indicated in the Fire-Resistive Joint System Schedule at the end of Part 3.

1. Hilti, Inc.
2. BioFireshield; RectorSeal Corporation.
3. Specified Technologies, Inc. (STI).
4. 3M; Fire Protection Products Division.

2.2 FIRE-RESISTIVE JOINT SYSTEMS

A. Compatibility: Provide fire-resistive joint systems that are compatible with joint substrates, under conditions of service and application, as demonstrated by fire-resistive joint system manufacturer based on testing and field experience.

B. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article. Use only components specified by fire-resistive joint system manufacturer and approved by the qualified testing and inspecting agency for systems indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of work.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Clean joints immediately before installing fire-resistive joint systems to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:

1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of fill materials.
2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with fill materials. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by fire-resistive joint system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent fill materials of fire-resistive joint system from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from fire-resistive joint system materials. Remove tape as soon as possible without disturbing fire-resistive joint system's seal with substrates or damaging adjoining surfaces.

3.3 INSTALLATION

A. General: Install fire-resistive joint systems to comply with Part 1 "Performance Requirements" Article and fire-resistive joint system manufacturer's written installation instructions for products and applications indicated.

B. Install forming/packing/backing materials and other accessories of types required to support fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

C. Install fill materials for fire-resistive joint systems by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings and forming/packing/backing materials as required to achieve fire-resistance ratings indicated.
2. Apply fill materials so they contact and adhere to substrates formed by joints.
3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 FIELD QUALITY CONTROL

A. Inspecting Agency: Engage a qualified independent inspecting agency to inspect fire-resistive joint systems and prepare inspection reports.

B. Testing Services: Inspecting of completed installations of fire-resistive joint systems shall take place in successive stages as installation of fire-resistive joint systems proceeds. Do not proceed with installation of joint systems for the next area until inspecting agency determines completed work shows compliance with requirements.

1. Inspecting agency shall state in each report whether inspected fire-resistive joint systems comply with or deviate from requirements.

C. Remove and replace fire-resistive joint systems where inspections indicate that they do not comply with specified requirements.

D. Additional inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

E. Proceed with enclosing fire-resistive joint systems with other construction only after inspection reports are issued and fire-resistive joint systems comply with requirements.

3.5 CLEANING AND PROTECTING

A. Clean off excess fill materials adjacent to joints as Work progresses by methods and with cleaning materials that are approved in writing by fire-resistive joint system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure fire-resistive joint systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

3.6 TESTED (DYNAMIC) JOINT FIRESTOP SYSTEM SCHEDULE

JOINT TYPE	F-RATING	UL-CLASSIFIED SYSTEM NUMBER							
		JOINT WIDTH LESS THAN OR EQUAL TO 2"				JOINT WIDTH LESS THAN OR EQUAL TO 6"			
		HILTI	STI	3M	BIO-FIRESHIELD	HILTI	STI	3M	BIO-FIRESHIELD
CONCRETE FLOOR-TO-FLOOR	1	see note 2	see note 2	FF-D-0002	N/A**	FF-D-1026, FF-D-1039	FF-D-1008, FF-D-1025	FF-D-1002, FF-D-1003, FF-D-1004	N/A**
	2	see note 2	see note 2	FF-D-0002	N/A**	FF-D-1026, FF-D-1039	FF-D-1008, FF-D-1025	FF-D-1002, FF-D-1003, FF-D-1004	N/A**
	3	see note 2	see note 2	N/A**	N/A**	FF-D-1026, FF-D-1039	FF-D-1008, FF-D-1025	N/A**	N/A**
EDGE OF CONCRETE FLOOR SLAB-TO-WALL (also see CURTAIN WALLS & note 1))	1	see note 2	see note 2	-	N/A**	FW-D-1011, FW-D-1012, FW-D-1013, FW-D-1021	FW-D-1007, FW-D-1035	FW-D-1002, FW-D-1003, FW-D-1009	FW-D-1023
	2	see note 2	see note 2	-	N/A**	FW-D-1011, FW-D-1012, FW-D-1013, FW-D-1021	FW-D-1007, FW-D-1035	FW-D-1002, FW-D-1003, FW-D-1009	FW-D-1023
	3	see note 2	see note 2	-	N/A**	FW-D-1011, FW-D-1021	FW-D-1007, FW-D-1035	FW-D-1002, FW-D-1009	N/A**

CONCRETE OR BLOCK WALL TO FLAT CONCRETE SLAB FLOOR (TOP-OF-WALL)	1	HW-D-0097	HW-D-1006, HW-D-1034	HW-D-0023, HW-D-0029	HW-D-0114	HW-D-1008, HW-D-1009	HW-D-1006, HW-D-1034	HW-D-1003	HW-D-1023
	2	HW-D-0097	HW-D-1006, HW-D-1034	HW-D-0023, HW-D-0029	HW-D-0114	HW-D-1008, HW-D-1009	HW-D-1006, HW-D-1034	HW-D-1003	HW-D-1023
	3	see note 2	HW-D-1006, HW-D-1034	-	HW-D-0114	HW-D-1008		HW-D-1002, HW-D-1007	N/A**
CONCRETE OR BLOCK WALL TO CONCRETE OVER FLUTED METAL DECK (TOP-OF-WALL)	1	HW-D-0080, HW-D-0081, HW-D-0098, HW-D 0181	HW-D-0086	HW-D-0022, HW-D-0030, HW-D-0040HW-D-0013	HW-D-0200	HW-D-1037, HW-D 1041			N/A**
	2	HW-D-0080, HW-D-0081, HW-D-0098, HW-D 0181	HW-D-0086	HW-D-0022, HW-D-0030, HW-D-0040HW-D-0013	HW-D-0200	HW-D-1037, HW-D 1041			N/A**
	3	N/A**	HW-D-0086	N/A**	N/A**	N/A**			N/A**
GYPSUM WALL TO FLAT CONCRETE SLAB FLOOR (TOP-OF-WALL)	1	HW-D-0082, HW-D-0083, HW-D-0097	HW-D-0079, HW-D-0044	HW-D-0012, HW-D-0021	HW-D-0180	N/A**	N/A**		
	2	HW-D-0082, HW-D-0083, HW-D-0097	HW-D-0079, HW-D-0044	HW-D-0012, HW-D-0021	HW-D-0180	N/A**	N/A**		
	3	N/A**	HW-D-0044	N/A**	N/A**	N/A**	N/A**		

GYPSUM WALL TO CONCRETE OVER FLUTED METAL DECK (TOP-OF-WALL)	1	HW-D-0042, HW-D-0049, HW-D-0076, HW-D-0264	HW-D-0043	HW-D-0011, HW-D-0020, HW-D-0031	HW-D-0033	N/A**	N/A**		
	2	HW-D-0042, HW-D-0049, HW-D-0076, HW-D-0264	HW-D-0043	HW-D-0011, HW-D-0020, HW-D-0031	HW-D-0033	N/A**	N/A**		
	3	HW-D-292	HW-D-0043	N/A**	N/A**	N/A**	N/A**		
CONCRETE WALL-TO-WALL	1	WW-D-0017, WW-D-0032	WW-D-1007, WW-D-1037	-	WW-D-0009	WW-D-1011, WW-D-1012	N/A**	WW-D-1003, WW-D-1004, WW-D-1010	N/A**
	2	WW-D-0017, WW-D-0032	WW-D-1007, WW-D-1037	-	WW-D-0009	WW-D-1011, WW-D-1012	WW-D-1007, WW-D-1037	WW-D-1003, WW-D-1004, WW-D-1010	N/A**
	3	-	WW-D-1007, WW-D-1037	-	WW-D-0010	WW-D-1011	WW-D-1007, WW-D-1037	WW-D-1003, WW-D-1010	N/A**
CURTAIN WALLS (see note 1)		JOINT WIDTH LESS THAN OR EQUAL TO 6"				JOINT WIDTH LESS THAN OR EQUAL TO 8"			
EDGE OF FLOOR TO NON-RATED ALUMINUM & GLASS CURTAIN WALL	2 hr F Rating	CW-D-2027	CW-D-2042			CW-D-2026, CW-D-2027	CW-D-2042		CW-D-2019, CW-D-2015
EDGE OF FLOOR TO NON-RATED CONCRETE/STONE SPANDREL	2 hr F Rating	CW-D-1001	CW-D-2005			CW-D-2025	CW-D-2005	CW-D-2017	
EDGE OF FLOOR TO NON-RATED CURTAIN WALL WITH GALVANIZED STEEL BACK PAN	2 Hr F Rating	N/A	CW-S-0002	N/A	N/A	N/A	CW-S-0002	N/AN/A	N/A

** Contact manufacturer for current ul-classified system or engineer judgement drawing

Notes:

1. Edge of slab, curtain wall systems are also tested by omega point labs. Contact manufacturer for additional listings.
2. Classified systems for 2" - 6" wide joints may be used for joints 2" wide and less.
3. Confirm that movement capabilities of the selected ul system meets or exceeds the specified movement range of the particular joint.
4. System performance may be affected by factors such as metal stud width, joint width or the presence of fire-proofing materials within the joint. Consult individual details for specifications and limitations.

5. Head-of-wall systems specified only for 2- or 3-hr systems may not be suitable for masonry walls or gypsum wall assemblies with lower hourly ratings. Contact the firestop manufacturer for clarification

END OF SECTION 07 84 40

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Joint sealants and fillers.

B. This Section includes joint sealants for the applications specified with the products in this Section and as indicated on Drawings.

C. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

D. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 04 20 00 - UNIT MASONRY for masonry control and expansion joint fillers and gaskets.
2. Section 08 80 00 - GLAZING for glazing sealants.
3. Section 09 21 10 - GYPSUM BOARD ASSEMBLIES for sealing perimeter joints of gypsum board partitions to reduce sound transmission.
4. Section 09 30 00 - TILING for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
5. Section 09 51 00 - ACOUSTICAL CEILINGS for sealing edge moldings at perimeters of acoustical ceilings.

1.3 PERFORMANCE REQUIREMENTS

A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

1.4 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. LEED Submittals:

1. Credit IEQ 4.1: Manufacturers' product data for interior sealants and sealant primers, including printed statement of VOC content.

C. Samples for Verification: For each type and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

D. Qualification Data: For Installer.

E. Preconstruction Field Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on preconstruction testing specified in "Quality Assurance" Article.

F. Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:

1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

G. Field Test Report Log: For each elastomeric sealant application.

H. Product Test Reports: Based on comprehensive testing of product formulations performed by a qualified testing agency, indicating that sealants comply with requirements.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized Installer who is approved or licensed for installation of elastomeric sealants required for this Project.

B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

C. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.

1. Use manufacturer's standard test method to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
2. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
3. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.
4. Testing will not be required if joint-sealant manufacturers submit joint preparation data that are based on previous testing of current sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

D. Preconstruction Field-Adhesion Testing: Before installing elastomeric sealants, field test their adhesion to Project joint substrates as follows:

1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
2. Conduct field tests for each application indicated below:

a. Each type of elastomeric sealant and joint substrate indicated.
b. Each type of nonelastomeric sealant and joint substrate indicated.

3. Notify Architect seven days in advance of dates and times when test joints will be erected.

a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193.

1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

4. Report whether sealant in joint connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
5. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1.6 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer[or are below 40 deg F
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.7 WARRANTY

A. Special Installer's Warranty: Installer's standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer's standard form in which elastomeric sealant manufacturer agrees to furnish elastomeric joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

C. Special warranties specified in this Article exclude deterioration or failure of elastomeric joint sealants from the following:

1. Movement of the structure resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression caused by structural settlement or errors attributable to design or construction.
2. Disintegration of joint substrates from natural causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.

B. VOC Content of Interior Sealants: Provide interior sealants and sealant primers that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Architectural Sealants: 250 g/L.
2. Sealant Primers for Nonporous Substrates: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.

C. Colors of Exposed Joint Sealants: As indicated by manufacturer's designations.

2.2 JOINT SEALANTS

A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

B. Stain-Test-Response Characteristics: Elastomeric sealants shall be nonstaining to porous substrates. Provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

C. Suitability for Contact with Food: Where elastomeric sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

D. Single-Component Neutral-Curing Silicone Sealant:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Dow Corning Corporation; 790.
b. GE Silicones; SilPruf LM SCS2700.
c. Tremco Inc.; Spectrem 1.
d. Pecora Corporation; 864.

e. May National Bondaflex Sil 290

2. Extent of Use: Joints in exterior vertical and soffit surfaces.

E. Multicomponent Pourable Urethane Sealant:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Bostik Findley; Chem-Calk 550.
b. Meadows, W. R., Inc.; POURTHANE.
c. Pecora Corporation; Urexpan NR-200.
d. Tremco Inc.; THC-901.
e. May National Bondaflex PUR 2 SL

2. Extent of Use: Joints in exterior horizontal surfaces.

F. Single-Component Mildew-Resistant Acid-Curing Silicone Sealant:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Dow Corning Corporation; 786 Mildew Resistant.
b. GE Silicones; Sanitary SCS1700.
c. Tremco Inc.; Tremsil 200.
d. May National Bondaflex Sil 100 WF

2. Extent of Use: Sanitary joints at toilet rooms.

G. Latex Sealant: Comply with ASTM C 834, Type P, Grade NF.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Bostik Findley; Chem-Calk 600.
b. Pecora Corporation; AC-20+.
c. Sonneborn, BASF Building Systems; Sonolac.
d. Tremco Inc.; Tremflex 834.
e. May National Bondaflex Sil-A 700

2.3 JOINT-SEALANT BACKING

A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 26 deg F. Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and to otherwise contribute to optimum sealant performance.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.4 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include concrete, masonry and unglazed surfaces of ceramic tile.
3. Remove laitance and form-release agents from concrete.
4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following metal, glass, porcelain enamel and glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates, where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.

3.4 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed and cured sealant joints as follows:
   a. Perform 1 test for each **1000 feet** of joint length thereafter or 1 test per each floor per elevation.
2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
   a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
3. Inspect tested joints and report on the following:
   a. Whether sealants filled joint cavities and are free of voids.
   b. Whether sealant dimensions and configurations comply with specified requirements.
   c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.
4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.
5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

B. Evaluation of Field-Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.6 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION 07 92 00

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Architectural expansion joint systems for interior and exterior joints as scheduled on the Drawings and specified in this Section.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 03 30 00 - CAST-IN-PLACE CONCRETE for block-outs for architectural joint systems in concrete floors, decks, and walls.
2. Section 07 92 00 - JOINT SEALANTS for elastomeric sealants and preformed compressed-foam sealants without metal frames.

1.3 DEFINITIONS

A. Architectural Joint System: Any filler or cover used to span, fill, cover, or seal a joint, except expanding foam seals and poured or foamed in-place sealants.

B. Cyclic Movement: Periodic change between widest and narrowest joint widths in an automatically mechanically controlled system.

C. Fire Barriers: Any material or material combination, when fire tested after cycling, designated to resist passage of flame and hot gases through a movement joint.

D. Maximum Joint Width: Widest linear gap a joint system tolerates and performs its designed function without damaging its functional capabilities.

E. Minimum Joint Width: Narrowest linear gap a joint system tolerates and performs its designed function without damaging its functional capabilities.

F. Movement Capability: Value obtained from the difference between widest and narrowest widths of a joint opening typically expressed in numerical values (mm or inches) or a percentage of nominal value of joint width.

G. Nominal Joint Width: Width of linear gap indicated as representing the conditions existing when architectural joint systems will be installed or, if no nominal joint width is indicated, a width equal to the sum of maximum and minimum joint widths divided by two.

1.4 PERFORMANCE REQUIREMENTS

A. General: Provide factory-fabricated architectural joint systems capable of withstanding the types of loads and of accommodating the kinds of movement, and the other functions for which they are designed including those specified below, without failure. Types of failure include those listed in Appendix X3 of ASTM E 1399.

1. Vehicular Traffic Joints: Support vehicular traffic across joint, including construction equipment and full-loaded fire apparatus.
2. Pedestrian Traffic Joints: Support pedestrian traffic across joint.
3. Exterior Joints: Maintain continuity of weather enclosure.
4. Joints in Fire-Resistance-Rated Assemblies: Maintain fire-resistance ratings of assemblies.
5. Joints in Smoke Barriers: Maintain integrity of smoke barrier.
6. Joints in Acoustically Rated Assemblies: Inhibit passage of airborne noise.
7. Other Joints: Where indicated, provide joint systems that prevent penetration of water, moisture, and other substances deleterious to building components or content.
8. Seismic Joints: Remain in place on exposure to seismic activity (movement).
9. Joints in Surfaces with Architectural Finishes: Serve as finished architectural joint closures.

1.5 SUBMITTALS

A. Product Data: Include manufacturer's product specifications, construction details, material and finish descriptions, and dimensions of individual components and seals.

B. Shop Drawings: For each joint system specified, provide the following:

1. Placement Drawings: Include line diagrams showing entire route of each joint system, plans, elevations, sections, details, joints, splices, locations of joints and splices, and attachments to other Work. Where joint systems change planes, provide Isometric Drawings depicting how components interconnect to achieve continuity of joint covers and fillers.

C. Samples for Verification: Full-size units 6 inches long of each type of joint system indicated; in sets for each finish, color, texture, and pattern specified, showing the full range of variations expected in these characteristics.

D. Product Test Reports: From a qualified testing agency indicating architectural joint systems comply with requirements, based on comprehensive testing of current products.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain architectural joint systems through one source from a single manufacturer. Coordinate compatibility with adjoining joint systems specified in other Sections.

B. Fire-Test-Response Characteristics: Where indicated, provide joint systems incorporating fire barriers that are identical to those of assemblies tested for fire resistance per ASTM E 119 and

ASTM E 814, including hose-stream test of vertical wall assemblies, by a testing and inspecting agency acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Balco, Inc.
2. Construction Specialties, Inc.
3. MM Systems Corporation.

B. Basis-of-Design: MM Systems.

2.2 MATERIALS

A. Aluminum: ASTM B 221, alloy 6063-T5 for extrusions; ASTM B 209, alloy 6061-T6 for sheet and plate.

1. Apply manufacturer's standard protective coating on aluminum surfaces to be placed in contact with cementitious materials.

B. Stainless Steel: ASTM A 666, Type 304 with No. 2B finish, unless otherwise indicated, for plates, sheet, and strips.

C. Preformed Seals: Single or multicellular extruded elastomeric seals designed with or without continuous, longitudinal, internal baffles. Formed to be installed in frames or with anchored flanges, in color indicated or, if not indicated, as selected by Architect from manufacturer's standard colors.

D. Strip Seals: Elastomeric membrane or tubular extrusions with a continuous longitudinal internal baffle system throughout complying with ASTM E 1783; used with compatible frames, flanges, and molded-rubber anchor blocks.

E. Compression Seals: Preformed, elastomeric extrusions having internal baffle system complying with ASTM E 1612 in sizes and profiles indicated or as recommended by manufacturer.

F. Preformed Cellular Foams: Nonextruded, low-density, crosslinked, nitrogen-blown ethylene-vinyl-acetate copolymer extruded, compressible foam.

G. Fire Barriers: Any material or material combination, when fire tested after cycling, designated to resist the passage of flame and hot gases through a movement joint.

H. Accessories: Manufacturer's standard anchors, clips, fasteners, set screws, spacers, flexible moisture barrier and filler materials, drain tubes, lubricants, adhesives, and other accessories compatible with material in contact, as indicated or required for complete installations.

2.3 ARCHITECTURAL JOINT SYSTEMS

A. General: Provide joint systems of design, basic profile, materials, and operation indicated. Provide units with the capability to accommodate joint widths indicated and variations in adjacent surfaces.

1. Furnish units in longest practicable lengths to minimize number of end joints. Provide hairline mitered corners where joint changes directions or abuts other materials.
2. Include closure materials and transition pieces, tee-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous joint systems.
3. Frames for Strip Seals: Designed with semiclosed cavity that provides a mechanical lock for seals of type indicated.
4. Public Area Seals: Non-slip seals designed for installation on treads and risers and to lie flat with adjacent surfaces, and complying with ADA guidelines for public areas.

2.4 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

2.5 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.

2.6 STAINLESS-STEEL FINISHES

A. Remove tool and die marks and stretch lines or blend into finish.

B. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.

C. Bright, Directional Polish: No. 4 finish.

D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare substrates according to architectural joint system manufacturer's written instructions.

B. Coordinate and furnish anchorages, Placement Drawings, and instructions for installing joint systems to be embedded in or anchored to concrete or to have recesses formed into edges of concrete slab for later placement and grouting-in of frames.

C. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary to secure joint systems to in-place construction, including threaded fasteners with drilled-in expansion shields for masonry and concrete where anchoring members are not embedded in concrete. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of joint systems.

D. Provide the services of a surveyor licensed in the state the project is located prior to and after paving substrate to confirm alignment of joint.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions for handling and installing architectural joint assemblies and materials, unless more stringent requirements are indicated.

B. Coordinate installation of architectural joint assembly materials and associated work so complete assemblies comply with assembly performance requirements.

C. Terminate exposed ends of exterior architectural joint assemblies with factory-fabricated termination devices to maintain waterproof system.

D. Install factory-fabricated transitions between building expansion-joint cover assemblies and roof expansion-joint assemblies to provide continuous, uninterrupted, watertight construction.

E. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required to install joint systems.

1. Install joint cover assemblies in true alignment and proper relationship to joints and adjoining finished surfaces measured from established lines and levels.
2. Allow adequate free movement for thermal expansion and contraction of metal to avoid buckling.
3. Set covers in horizontal surfaces at elevations that place exposed surfaces flush with adjoining finishes.
4. Locate covers in continuous contact with adjacent surfaces.
5. Securely attach in place with required accessories.
6. Locate anchors at interval recommended by manufacturer, but not less than 3 inches from each end and not more than 24 inches o.c.

F. Continuity: Maintain continuity of joint systems with a minimum number of end joints and align metal members. Cut and fit ends to produce joints that will accommodate thermal expansion and contraction of metal to avoid buckling of frames. Adhere flexible filler materials, if any, to frames with adhesive or pressure-sensitive tape as recommended by manufacturer.

G. Extruded Preformed Seals: Install seals to comply with manufacturer's written instructions and with minimum number of end joints.

1. For straight sections, provide preformed seals in continuous lengths.
2. Vulcanize or heat-weld field splice joints in preformed seal material to provide watertight joints using procedures recommended by manufacturer.

3. Apply adhesive, epoxy, or lubricant adhesive approved by manufacturer to both frame interfaces before installing preformed seals.
4. Seal transitions according to manufacturer's written instructions.
5. Install foam seals with adhesive recommended by manufacturer and heat seal all splices.

H. Joint Systems with Seals: Seal end joints within continuous runs and joints at transitions according to manufacturer's written instructions to provide a watertight installation.

I. Seismic Seals: Install interior seals in continuous lengths. Install exterior seal in standard lengths and vulcanize or heat-weld field splice joints to provide watertight joints using manufacturer's recommended procedures. Seal transitions and end joints according to manufacturer's written instructions.

J. Fire Barriers: Install fire barriers to provide continuous, uninterrupted fire resistance throughout length of joint, including transitions and end joints.

3.3 CLEANING AND PROTECTION

A. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.

END OF SECTION 07 95 00

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Standard hollow-metal steel doors.
2. Standard hollow-metal steel frames.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 04 20 00 - UNIT MASONRY for building anchors into and grouting steel frames in masonry construction.
2. Section 08 34 70 - SOUND-CONTROL DOOR ASSEMBLIES for acoustic doors and frames.
3. Section 08 71 00 - DOOR HARDWARE for door hardware for steel doors.
4. Section 08 80 00 - GLAZING for glazed lites.
5. Section 09 90 00 - PAINTING AND COATING for field painting steel doors and frames.

1.3 SUBMITTALS

A. Product Data: Include construction details, material descriptions, core descriptions, label compliance, fire-resistance rating, temperature-rise ratings, and finishes for each type of steel door and frame specified.

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.
3. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.

B. Shop Drawings:

1. Elevations of each door design.
2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorages, joints, field splices, and connections.
7. Details of accessories.
8. Details of moldings, removable stops, and glazing.
9. Details of conduit and preparations for power, signal, and control systems.

C. Schedule: Provide a schedule of hollow metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with door hardware schedule.

D. Qualification Data: For Installer.

E. Product Test Reports: Based on evaluation of comprehensive fire tests performed by a qualified testing agency, for each type of standard steel door and frame.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Source Limitations: Obtain standard steel doors and frames through one source from a single manufacturer.

C. Fire-Rated Door, Sidelight and Transom Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated.

1. Temperature-Rise Limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F above ambient after 30 minutes of standard fire-test exposure.

D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver doors and frames palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch-high wood blocking. Do not store in a manner that traps excess humidity.

1. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.7 COORDINATION

A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Amweld Building Products, LLC.
2. Ceco Door Products; an ASSA ABLOY Group Company.
3. CURRIES Company; an ASSA ABLOY Group Company.
4. de LaFontaine
5. Mesker Door Inc.
6. Pioneer Industries, Inc.
7. Philipp Manufacturing Company.
8. Republic Builders Products Company.
9. Steelcraft; an Ingersoll-Rand company.

2.2 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 metallic coating.

D. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 40Z coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.

E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

F. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow metal frames of type indicated.

G. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M.

H. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool with 6- to 12-lb/cu. ft. density; with maximum flame-spread and smoke-development indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

I. Glazing: Comply with requirements in Section 08 80 00 - GLAZING.

J. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.3 STANDARD STEEL DOORS

A. General: Provide doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces, unless otherwise indicated. Comply with ANSI A250.8.

1. Design: Flush panel.
2. Core Construction: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, mineral-board, or vertical steel-stiffener core that produces doors complying with ANSI A250.8.
   a. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.
   b. Thermal-Rated (Insulated) Exterior Doors: Where indicated, provide doors fabricated with thermal-resistance value (R-value) of not less than 4.0 deg F x h x sq. ft./Btu when tested according to ASTM C 1363.
3. Top and Bottom Edges: Closed with flush or inverted 0.042-inch-thick end closures or channels of same material as face sheets.
4. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."

B. Exterior Doors: Face sheets fabricated from metallic-coated steel sheet. Provide doors complying with requirements indicated below by referencing ANSI A250.8 for level and model and ANSI A250.4 for physical-endurance level:

1. Level 3 and Physical Performance Level A (Extra Heavy Duty), Model 2 (Seamless), 1-3/4 inches thick.

C. Interior Doors: Face sheets fabricated from cold-rolled steel sheet, unless otherwise indicated to comply with exterior door requirements. Provide doors complying with requirements indicated below by referencing ANSI A250.8 for level and model and ANSI A250.4 for physical-endurance level:

1. Level 2 and Physical Performance Level B (Heavy Duty), Model 2 (Seamless), 1-3/4 inches thick.

D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

E. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

2.4 STANDARD STEEL FRAMES

A. General: Comply with ANSI A250.8 and with details indicated for type and profile.

B. Exterior Frames: Fabricated from metallic-coated steel sheet.

1. Fabricate frames with full profile welded joints.
2. Frames for Level 3 Steel Doors: 0.067-inch-thick steel sheet.

C. Interior Frames: Fabricated from cold-rolled steel sheet, unless otherwise indicated to comply with exterior frame requirements.

1. Fabricate frames with full profile welded joints.
2. Frames for Level 2 Steel Doors: 0.053-inch-thick steel sheet.

D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcement plates from same material as frames.

2.5 FRAME ANCHORS

A. Jamb Anchors:

1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
3. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.
4. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch-diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

B. Floor Anchors: Formed from same material as frames, not less than 0.042 inch (1.0 mm) thick, and as follows:

1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at finish floor surface.

2.6 HOLLOW METAL PANELS

A. Provide hollow metal panels of same materials, construction, and finish as specified for adjoining hollow metal work.

2.7 STOPS AND MOLDINGS

A. Moldings for Glazed Lites in Doors: Minimum 0.032 inch thick, fabricated from same material as door face sheet in which they are installed.

B. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch high unless otherwise indicated.

C. Loose Stops for Glazed Lites in Frames: Minimum 0.032 inch thick, fabricated from same material as frames in which they are installed.

2.8 LOUVERS

A. Provide louvers for interior doors, where indicated, that comply with SDI 111C, with blades or baffles formed of 0.020-inch-thick, cold-rolled steel sheet set into 0.032-inch-thick steel frame.

1. Sightproof Louver: Stationary louvers constructed with inverted V-shaped or Y-shaped blades.
2. Fire-Rated Automatic Louvers: Louvers constructed with movable blades closed by actuating fusible link, and listed and labeled for use in fire-rated door assemblies of type and fire-resistance rating indicated by same testing and inspecting agency that established fire-resistance rating of door assembly.

2.9 ACCESSORIES

A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.

B. Ceiling Struts: Minimum 1/4-inch-thick by 1-inch-wide steel.

C. Grout Guards: Formed from same material as frames, not less than 0.016 inch thick.

2.10 FABRICATION

A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Tolerances: Fabricate hollow metal work to tolerances indicated in SDI 117.

C. Hollow Metal Doors:

1. Exterior Doors: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
2. Glazed Lites: Factory cut openings in doors.
3. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted.

D. Hollow Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.

1. Full Profile Welded Frames: Weld joints continuously; grind, fill, dress, and make smooth, flush, and not visible.

2. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as doorframe. Fasten members at crossings and to jambs by butt welding.
3. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
4. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
5. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
6. Jamb Anchors: Provide number and spacing of anchors as follows:

    a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

        1) Two anchors per jamb up to 60 inches high.
        2) Three anchors per jamb from 60 to 90 inches high.
        3) Four anchors per jamb from 90 to 120 inches high.
        4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.

    b. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

        1) Three anchors per jamb up to 60 inches high.
        2) Four anchors per jamb from 60 to 90 inches high.
        3) Five anchors per jamb from 90 to 96 inches high.
        4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
        5) Two anchors per head for frames above 42 inches wide and mounted in metal-stud partitions.

    c. Compression Type: Not less than two anchors in each jamb.
    d. Postinstalled Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.

7. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Keep holes clear during construction.

    a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

E. Fabricate concealed stiffeners, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.

F. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Section 08 71 00 - DOOR HARDWARE.

1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
2. Reinforce doors and frames to receive nontemplated, mortised and surface-mounted door hardware.

3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 - ELECTRICAL.

G. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.

1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow metal work.
2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
4. Provide loose stops and moldings on inside of hollow metal work.
5. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.

2.11 STEEL FINISHES

A. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Prior to installation, adjust and securely brace welded hollow metal frames for squareness, alignment, twist, and plumbness to the following tolerances:

1. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.

2. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
3. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
4. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.

C. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11.

1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.

   a. At fire-protection-rated openings, install frames according to NFPA 80.
   b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
   c. Install frames with removable glazing stops located on secure side of opening.
   d. Install door silencers in frames before grouting.
   e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
   f. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
   g. Field apply bituminous coating to backs of frames that are filled with grout.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.

   a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind frames.
4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
5. Concrete Walls: Solidly fill space between frames and concrete with grout. Take precautions, including bracing frames, to ensure that frames are not deformed or damaged by grout forces.
6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
7. In-Place Gypsum Board Partitions: Secure frames in place with postinstalled expansion anchors through floor anchors at each jamb. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.

8. Ceiling Struts: Extend struts vertically from top of frame at each jamb to overhead structural supports or substrates above frame unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction. Provide adjustable wedged or bolted anchorage to frame jamb members.
9. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:

    a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
    c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Standard Steel Doors:

    a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
    b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch .
    c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
    d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
3. Smoke-Control Doors: Install doors according to NFPA 105.

D. Glazing: Comply with hollow metal manufacturer's written instructions.

1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

3.4 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow metal work immediately after installation.

C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

D. Metallic-Coated Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION 08 11 10

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Solid-core doors with wood-veneer and medium-density overlay faces.
2. Factory finishing for wood doors.
3. Factory fitting flush wood doors to frames and factory machining for hardware.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 08 71 00 - DOOR HARDWARE for hardware for wood doors.
2. Section 08 80 00 - GLAZING for glazing.
3. Section 099000 - PAINTING AND COATING for field finishing of wood doors.

1.3 SUBMITTALS

A. Product Data: For each type of door. Include details of core and edge construction, louvers, and trim for openings. Include factory-finishing specifications.

B. LEED Submittals:

1. Certificates for Credit MR 7: Chain-of-custody certificates certifying that flush wood doors comply with forest certification requirements. Include evidence that manufacturer and supplier is certified for chain of custody by an FSC-accredited certification body.
2. Product Data for Credit IEQ 4.4: For adhesives and composite wood products, indicating that product contains no urea formaldehyde.

C. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.

1. Indicate dimensions and locations of mortises and holes for hardware.
2. Indicate dimensions and locations of cutouts.
3. Indicate requirements for veneer matching.

4. Indicate doors to be factory finished and finish specifications.
5. Indicate fire ratings for fire doors.

D. Samples for Verification:

1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches for each material and finish. For each wood species and transparent finish, provide set of three samples showing typical range of color and grain to be expected in the finished work.
2. Frames for light openings, 6 inches long, for each material, type, and finish required.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain flush wood doors through one source from a single manufacturer.

B. Quality Standard: Comply with AWI/AWMAC/WI's "Architectural Woodwork Standards."

1. Provide AWI Quality Certification Program (QCP) labels or certificates indicating that doors comply with requirements of grades specified. Register the work under this Section with the AWI QCP.

C. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.

D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Package doors individually in plastic bags.

C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until building is enclosed, wet work is complete, and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form, signed by manufacturer, Installer, and Contractor, in which manufacturer agrees to repair or replace doors that are defective in materials or workmanship, have warped (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section, or show telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.

1. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.

2. Warranty shall include hardware installation and replacement of glass and glazing.
3. Warranty shall be in effect during the following period of time from date of Substantial Completion:
   a. Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Flush Wood Doors:

   a. Algoma Hardwoods Inc.
   b. Eggers Industries; Architectural Door Division.
   c. Lambton Doors.
   d. Marshfield Door Systems.
   e. VT Industries Inc.

2.2 DOOR CONSTRUCTION, GENERAL

A. Forest Certification: Provide doors made from wood products obtained from forests certified by an FSC-accredited certification body to comply with FSC 1.2, "Principles and Criteria."

B. Low-Emitting Materials: Provide doors made with adhesives and composite wood products that contain no added urea formaldehyde.

C. Doors for Transparent Finish:

1. Grade: AWI Premium, with AWI Grade A faces.
2. Species and Cut: Select White Maple, plain cut.
3. Match between Veneer Leaves: Book match.
4. Assembly of Veneer Leaves on Door Faces: Running match.
5. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
6. Transom Match: Continuous match.
7. Stiles: Same species as faces.
8. Cross-Banding: 1/8 in. high density fiberboard, urea formaldehyde free.

D. Doors for Opaque Finish:

1. Grade: Premium.
2. Faces for Interior Doors: Medium-density overlay.
3. Apply medium-density overlay directly to high-density hardboard crossbands.

2.3 SOLID-CORE DOORS

A. Cores: Comply with the following requirements:

1. Particle Core: ANSI A 208.1, Grade 1-LD-2 contributes to MR 4.1 and MR 4.2.

2. Stave Lumber Core: FSC Certified contributes to MR 7 and IEQ 4.4.
3. Agrifiber Core: ANSI A 208.1, Grade 1-LD-2 contributes to MR 4.1. MR 4.2, MR 6, and IEQ 4.4.
4. Structural Composite Lumber Core: Timberstrand LSL contributes to IEQ 4.4.
5. Provide doors with structural composite lumber cores instead of particleboard cores at locations where exit devices are indicated or where light or louver cutouts exceed 40% of the door area.

B. Interior Veneer-Faced Doors:

1. Construction: Five plies, hot-pressed, with stiles and rails bonded to core, then entire unit abrasive planed before veneering.

C. Fire-Rated Doors:

1. Construction: Construction and core specified above for type of face indicated or manufacturer's standard mineral-core construction as needed to provide fire rating indicated.
   a. Fire Retardant Mineral Core, with added urea formaldehyde free cross-banding, contributes to IEQ 4.4.
2. Blocking: For mineral-core doors, provide composite blocking with improved screw-holding capability approved for use in doors of fire ratings indicated as needed to eliminate through-bolting hardware.
3. Edge Construction: At hinge stiles, provide manufacturer's standard laminated-edge construction with improved screw-holding capability and split resistance and with outer stile matching face veneer.
4. Pairs: Provide fire-rated pairs with fire-retardant stiles matching face veneer that are labeled and listed for kinds of applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals.

2.4 LIGHT FRAMES

A. Wood Beads for Light Openings in Wood Doors:

1. Wood Species: Same species as door faces.
2. Profile: Manufacturer's standard shape.
3. At 20-minute, fire-rated, wood-core doors, provide wood beads and metal glazing clips approved for such use.

B. Wood-Veneered Beads for Light Openings in Fire Doors: Manufacturer's standard wood-veneered noncombustible beads matching veneer species of door faces and approved for use in doors of fire rating indicated. Include concealed metal glazing clips where required for opening size and fire rating indicated.

2.5 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated, with the following uniform clearances and bevels, unless otherwise indicated:

1. Comply with clearance requirements of referenced quality standard for fitting. Comply with requirements in NFPA 80 for fire-rated doors.

B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.

1. Coordinate measurements of hardware mortises in metal frames to verify dimensions and alignment before factory machining. Drill pilot holes for screws for butt hinges and lock fronts at the factory.
2. Metal Astragals: Premachine astragals and formed-steel edges for hardware for pairs of fire-rated doors to receive concealed vertical rod exit devices.

C. Transom and Side Panels: Fabricate matching panels with same construction, exposed surfaces, and finish as specified for associated doors. Finish bottom edges of transoms and top edges of rabbeted doors same as door stiles.

1. Fabricate door and transom panels with full-width, solid-lumber meeting rails. Provide factory-installed spring bolts for concealed attachment into jambs of metal doorframes.

D. Openings: Cut and trim openings through doors to comply with applicable requirements of referenced standards for kind(s) of door(s) required.

1. Light Openings: Trim openings with moldings of material and profile indicated.

2.6 SHOP PRIMING

A. Doors for Opaque Finish: Shop prime faces and edges of doors, including cutouts, with one coat of wood primer specified in Section 09 90 00 - PAINTING AND COATING.

2.7 FACTORY FINISHING

A. General: Comply with AWI's "Architectural Woodwork Quality Standards Illustrated" for factory finishing.

B. Finish doors at factory that are indicated to receive transparent finish. Factory prime and prepare for field finish doors indicated to receive opaque finish.

C. Transparent Finish:

1. Grade: Premium.
2. Finish: Manufacturer's standard catalyzed polyurethane finish with performance comparable to AWS System 11. Provide two finish coats.
3. Staining: As selected by Architect from manufacturer's full range.
4. Effect: Semifilled finish.
5. Sheen: Satin.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and installed door frames before hanging doors.

1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
2. Reject doors with defects.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Hardware: For installation, see Section 08 71 00 - DOOR HARDWARE.

B. Manufacturer's Written Instructions: Install doors to comply with manufacturer's written instructions, referenced quality standard, and as indicated.

1. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80.

C. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

3.3 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Protection: Provide temporary protection to ensure work being without damage or deterioration at time of final acceptance. Remove protections and reclean as necessary immediately before final acceptance.

C. Finished Doors: Replace doors that are damaged or do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 08 14 00

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Access doors and frames for walls and ceilings.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 03 30 00 - CAST-IN-PLACE CONCRETE for blocking out openings for access doors and frames in concrete.
2. Section 04 20 00 - UNIT MASONRY for anchoring and grouting access door frames set in masonry construction.
3. Section 08 71 00 - DOOR HARDWARE for rim cylinder locks and master keying.

1.3 SUBMITTALS

A. Product Data: For each type of access door and frame indicated. Include construction details, fire ratings, materials, individual components and profiles, and finishes.

B. Shop Drawings: Show fabrication and installation details of access doors and frames for each type of substrate. Include plans, elevations, sections, details, and attachments to other work.

C. Samples: For each door face material, at least 3 by 5 inches in size, in specified finish.

D. Access Door and Frame Schedule: Provide complete access door and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.

E. Ceiling Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted items including access doors and frames, lighting fixtures, diffusers, grilles, speakers, sprinklers, and special trim are shown and coordinated with each other.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain[each type of access door and frame through one source from a single manufacturer.

B. Fire-Rated Access Doors and Frames: Units complying with NFPA 80 that are identical to access door and frame assemblies tested for fire-test-response characteristics per the following test method and that are listed and labeled by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. NFPA 252 for vertical access doors and frames.
2. ASTM E 119 for horizontal access doors and frames.

C. Size Variations: Obtain Architect's acceptance of manufacturer's standard-size units, which may vary slightly from sizes indicated.

1.5 COORDINATION

A. Verification: Determine specific locations and sizes for access doors needed to gain access to concealed plumbing, mechanical, or other concealed work, and indicate in the schedule specified in "Submittals" Article.

PART 2 - PRODUCTS

2.1 STEEL MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

1. ASTM A 123/A 123M, for galvanizing steel and iron products.
2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.

B. Steel Sheet: Electrolytic zinc-coated, ASTM A 591/A 591M with cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.

C. Steel Finishes: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Surface Preparation for Steel Sheet: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."

a. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

2. Factory-Primed Finish: Apply shop primer immediately after cleaning and pretreating.

D. Drywall Beads: Edge trim formed from 0.0299-inch zinc-coated steel sheet formed to receive joint compound and in size to suit thickness of gypsum board.

2.2 STAINLESS-STEEL MATERIALS

A. Rolled-Stainless-Steel Floor Plate: ASTM A 793, manufacturer's standard finish.

B. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 316. Remove tool and die marks and stretch lines or blend into finish.

1. Finish: Directional Satin Finish, No. 4.

2.3 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Acudor Products, Inc.
2. Babcock-Davis; A Cierra Products Co.
3. Dur-Red Products.
4. J. L. Industries, Inc.
5. Karp Associates, Inc.
6. Larsen's Manufacturing Company.
7. Milcor Inc.
8. Nystrom, Inc.

B. Flush Access Doors and Trimless Frames: Fabricated from steel sheet at typical areas and from stainless-steel sheet at toilet and wet areas.

1. Locations: Wall and ceiling surfaces.
2. Door: Minimum 0.060-inch-thick sheet metal, set flush with surrounding finish surfaces.
3. Frame: Minimum 0.060-inch-thick sheet metal with drywall bead flange.
4. Hinges: Continuous piano.
5. Lock: Cylinder.

a. Lock Preparation: Prepare door panel to accept cylinder specified in Section 08 71 00, DOOR HARDWARE.

C. Recessed Access Doors and Trimless Frames: Fabricated from steel sheet at typical areas and from stainless-steel sheet at toilet and wet areas.

1. Locations: Wall and ceiling surfaces.
2. Door: Minimum 0.060-inch-thick sheet metal in the form of a pan recessed 5/8 inch for gypsum board infill.
3. Frame: Minimum 0.060-inch-thick sheet metal with drywall bead for gypsum board surfaces.
4. Hinges: Concealed pivoting rod hinge.
5. Lock: Cylinder.

a. Lock Preparation: Prepare door panel to accept cylinder specified in Section 08 71 00, DOOR HARDWARE.

D. Fire Rated, Uninsulated, Flush Access Doors and Frames with Exposed Trim: Fabricated from steel at typical areas and from stainless-steel sheet at toilets and wet areas.

1. Locations: Wall surfaces.
2. Fire-Resistance Rating: Not less than that of adjacent construction.
3. Door: Minimum 0.060-inch-thick sheet metal, flush construction.
4. Frame: Minimum 0.060-inch-thick sheet metal with 1-inch-wide, surface-mounted trim.
5. Hinges: Continuous piano.
6. Automatic Closer: Spring type.
7. Lock: Self-latching device with cylinder lock.

    a. Lock Preparation: Prepare door panel to accept cylinder specified in Section 08 71 00, DOOR HARDWARE

2.4 FABRICATION

A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.

B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of supports indicated.

1. For trimless frames with drywall bead, provide edge trim for gypsum board and gypsum base securely attached to perimeter of frames.
2. For trimless frames with plaster bead for full-bed plaster applications, provide zinc-coated expanded metal lath and exposed casing bead welded to perimeter of frames.
3. Provide mounting holes in frames for attachment of units to metal or wood framing.
4. Provide mounting holes in frame for attachment of masonry anchors.

D. Recessed Access Doors: Form face of panel to provide recess for application of applied finish. Reinforce panel as required to prevent buckling.

1. For recessed doors with plaster infill, provide self-furring expanded metal lath attached to door panel.

E. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.

1. For cylinder lock, furnish two keys per lock and key all locks alike.
2. For recessed panel doors, provide access sleeves for each locking device. Furnish plastic grommets and install in holes cut through finish.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with manufacturer's written instructions for installing access doors and frames.

B. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces.

C. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

3.2 ADJUSTING AND CLEANING

A. Adjust doors and hardware after installation for proper operation.

B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION 08 31 10

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Metal sound-control doors at NTC, SEM, and TEM laboratories.
2. Steel frames and sound-control seals.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 04 20 00 - UNIT MASONRY for building anchors into and grouting steel frames in masonry construction.
2. Section 08 11 10 - HOLLOW METAL DOORS AND FRAMES for standard flush metal doors.
3. Section 08 71 00 - DOOR HARDWARE for door hardware not provided by this section.
4. Section 08 80 00 - GLAZING for glazed lites.
5. Section 09 90 00 - PAINTING AND COATING for field finishing doors and frames.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include sound ratings, construction details, material descriptions, core descriptions, fire-resistance rating, temperature-rise ratings, and finishes. Include factory-finishing specifications.

B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.

1. Indicate dimensions and locations of mortises and holes for hardware.
2. Indicate dimensions and locations of cutouts.
3. Indicate requirements for veneer matching.
4. Indicate doors to be factory finished and finish requirements.
5. Indicate fire ratings for fire doors.
6. Details of sound-control seals, door bottoms, and thresholds.

C. Samples for Verification:

1. Frames for light openings, 6 inches long, for each material, type, and finish required.

D. LEED Submittals:

1. Credit MR 4: Product data indicating percentage by weight of post-consumer and pre-consumer recycled content for products having recycled content. Include a statement indicating costs for each product having recycled content.
2. Credit MR 5: Product data indicating location of material manufacturer and extraction. Include statement indicating cost and distance from each place of manufacturer and extraction to Project Site for each regionally manufactured material.

E. Schedule: Provide a schedule of sound-control door assemblies prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with the Door Hardware Schedule.

F. Product Certificates: For each type of sound-control door assembly, from manufacturer.

G. Field Test Report.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain sound-control door assemblies, including doors, frames, sound-control seals, hinges (when integral for sound control), thresholds, and other items essential for sound control, from single source from single manufacturer.

B. Fire-Rated Doors and Frames: Doors and frames complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.

C. Acoustical Testing Agency Qualifications: An independent agency accredited as an acoustical laboratory according to the National Voluntary Laboratory Accreditation Program of NIST.

D. Sound Rating: Provide sound-control door assemblies identical to those of assemblies tested as sound-retardant units by an acoustical testing agency, and have the following minimum rating:

1. STC Rating: 50, as determined by ASTM E 413 when tested in an operable condition according to ASTM E 90 and ASTM E 1408.

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Package doors individually in plastic bags or cardboard cartons.

C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install metal sound-control doors until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of sound-control door assemblies that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure to meet sound rating requirements.
b. Faulty operation of sound seals.
c. Deterioration of metals, metal finishes, and other materials beyond normal use or weathering.

2. Warranty shall be in effect during the following period of time from date of Substantial Completion:
a. Steel Doors: Five years.

PART 2 - PRODUCTS

2.1 METAL SOUND-CONTROL DOORS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AMBICO Limited.
2. Krieger Specialty Products Company.
3. Overly Door Company.

B. Basis-of-Design: Series SC, Model No. 509391 by Overly Door Co.

C. Description: Provide flush-design sound-control doors, 1-3/4 inches thick; with manufacturer's standard sound-retardant core as required to provide STC and fire rating indicated. Pair of metal doors with one active leaf. Active leaf includes single lite with acoustic glazing.

D. Doors: Flush-design sound control doors, 1-3/4 inches of seamless construction; with manufacturer's standard sound-retardant core as required to provide STC and fire rating indicated. Construct doors with smooth, flush surfaces without visible joints or seams on exposed faces or stile edges. Fabricate according to NAAMM-HMMA 865.

1. Interior Doors: Fabricate from cold-rolled steel sheet unless otherwise indicated, 0.048-inch nominal thickness or thicker as required to achieve STC rating indicated.
2. Core: Manufacturer's standard sound control core.
3. Loose Stops for Glazed Lites in Doors: Same material as face sheets.
4. Top and Bottom Channels: Closed with continuous channels of same material as face sheets, spot welded to face sheets not more than 6 inches o.c.

5. Hardware Reinforcement: Same material as face sheets.

E. Materials:

1. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B, suitable for exposed applications.
2. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
3. Glazing: As required by sound control door assembly manufacturer to comply with sound control and fire-rated-door labeling requirements.

F. Finishes:

1. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.

   a. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

G. Fabrication: Sound control doors to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal.

1. Comply with requirements in NFPA 80 for fire-rated and smoke control doors.
2. Seamless Edge Construction: Fabricate doors with faces joined at vertical edges by welding; welds shall be ground, filled, and dressed to make them invisible and to provide a smooth, flush surface.
3. Glazed Lites: Factory install glazed lites according to requirements of tested assembly to achieve STC rating indicated. Provide fixed stops and moldings welded on secure side of door.
4. Hardware Preparation: Factory prepare sound control doors to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping.

   a. Reinforce doors to receive nontemplated mortised and surface-mounted door hardware.
   b. Locate door hardware as indicated, or if not indicated, according to NAAMM-HMMA 831, "Recommended Hardware Locations for Custom Hollow Metal Doors and Frames."

5. Tolerances: Fabricate doors to tolerances indicated in NAAMM-HMMA 865.

2.2 SOUND-CONTROL FRAMES

A. Description: Fabricate sound-control door frames with corners mitered, reinforced, and continuously welded full depth and width of frame. Fabricate according to ANSI/NAAMM-HMMA 865.

1. Weld frames according to NAAMM-HMMA 820.
2. Interior Frames: Fabricate from cold-rolled steel sheet unless otherwise indicated, 0.075-inch nominal thickness, or thicker as required to provide STC rating indicated.

3. Sound-Control Panel Stops: Formed integral with frames, a minimum of 5/8 inch high, unless otherwise indicated.
4. Hardware Reinforcement: Fabricate according to ANSI/NAAMM-HMMA 865 of same material as face sheets.
5. Head Reinforcement: Reinforce frames with metallic-coated steel channel or angle stiffener, 0.108-inch nominal thickness, welded to head.
6. Jamb Anchors:

    a. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.064-inch nominal thickness metallic-coated steel with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.156 inch thick.
    b. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.048-inch nominal thickness uncoated steel unless otherwise indicated.
    c. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch- diameter, metallic-coated steel bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

7. Floor Anchors: Not less than 0.079-inch nominal thickness metallic-coated steel, and as follows:

    a. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
    b. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at finish floor surface.

8. Ceiling Struts: Minimum 3/8-inch-thick by 2-inch- wide uncoated steel unless otherwise indicated.
9. Plaster Guards: Metallic-coated steel sheet, not less than 0.026 inch thick.

B. Materials:

1. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B, suitable for exposed applications.
2. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
3. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B, with G60 zinc (galvanized) or A40 zinc-iron-alloy (galvannealed) coating designation.
4. Supports and Anchors: After fabricating, galvanize units to be built into exterior walls according to ASTM A 153/A 153M, Class B.
5. Inserts, Bolts, and Fasteners: Provide items to be built into exterior walls, hot-dip galvanized according to ASTM A 153/A 153M or ASTM F 2329.
6. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching sound-control door frames of type indicated.
7. Mineral-Fiber Insulation: Insulation composed of rock-wool fibers, slag-wool fibers, or glass fibers.

C. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

2.3 SOUND-CONTROL HARDWARE

A. Description: Provide manufacturer's standard sound-control system, including head and jamb seals, door bottoms, cam-lift hinges, and thresholds, as required by testing to achieve STC and fire rating indicated.

1. Compression Seals: One-piece units; consisting of closed-cell sponge neoprene seal held in place by metal retainer; with retainer cover of same material as door frame; attached to door frame with concealed screws.
2. Magnetic Seals: One-piece units; consisting of closed-cell sponge neoprene seal and resiliently mounted magnet held in place by metal retainer; with retainer cover of same material as door frame; attached to door frame with concealed screws.
3. Automatic Door Bottoms: Neoprene or silicone gasket, held in place by metal housing, that automatically drops to form seal when door is closed; mounted to bottom edge of door with screws.
4. Door Bottoms: Neoprene or silicone gasket held in place by metal housing; mortised into bottom edge of door.
5. Cam-Lift Hinges: Full-mortise template type that raises door 1/2 inch when door is fully open; with hardened pin; fabricated from stainless steel.
6. Thresholds: Flat, smooth, unfluted type as recommended by manufacturer. Material and finish as required by Door Hardware Schedule.

B. Other Hardware: Comply with requirements in Section 08 71 00 - DOOR HARDWARE.

2.4 SOUND-CONTROL ACCESSORIES

A. Glazing: Comply with requirements in Section 08 80 00 - GLAZING.

B. Grout: Comply with ASTM C 476, with a slump of not more than 4 inches as measured according to ASTM C 143/C 143M.

C. Corrosion-Resistant Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.5 FABRICATION

A. Sound-Control Steel Door Fabrication: Sound-control doors to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal.

1. Seamless Edge Construction: Fabricate doors with faces joined at vertical edges by welding; welds shall be ground, filled, and dressed to make them invisible and to provide a smooth, flush surface.
2. Glazed Lites: Factory install glazed lites according to requirements of tested assembly to achieve STC rating indicated. Provide fixed stops and moldings welded on secure side of door.

3. Hardware Preparation: Factory prepare sound-control doors to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping, according to the Door Hardware Schedule and templates furnished as specified.

   a. Reinforce doors to receive nontemplated mortised and surface-mounted door hardware.
   b. Locate door hardware as indicated, or if not indicated, according to NAAMM-HMMA 831, "Recommended Hardware Locations for Custom Hollow Metal Doors and Frames."

4. Tolerances: Fabricate doors to tolerances indicated in ANSI/NAAMM-HMMA 865.

B. Sound-Control Door Fabrication: Factory fit doors to suit frame-opening sizes indicated, with uniform clearances and bevels according to referenced quality standard, unless otherwise indicated. Comply with final door hardware schedules and hardware templates.

1. Comply with clearance requirements in NFPA 80 for fire-rated doors.

C. Sound-Control Frame Fabrication: Fabricate sound-control frames to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

1. Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible. Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated from same thickness metal as frames.
2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
3. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
4. Jamb Anchors: Provide number and spacing of anchors as follows:

   a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

      1) Two anchors per jamb up to 60 inches in height.
      2) Three anchors per jamb from 60 to 90 inches in height.
      3) Four anchors per jamb from 90 to 96 inches in height.
      4) Four anchors per jamb plus one additional anchor per jamb for each 24 inches or fraction thereof more than 96 inches in height.

   b. Stud Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

      1) Three anchors per jamb up to 60 inches in height.
      2) Four anchors per jamb from 60 to 90 inches in height.
      3) Five anchors per jamb from 90 to 96 inches in height.
      4) Five anchors per jamb plus one additional anchor per jamb for each 24 inches or fraction thereof more than 96 inches in height.

5) Two anchors per head for frames more than 42 inches wide and mounted in metal stud partitions.

c. Postinstalled Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.

5. Head Reinforcement: For frames more than 48 inches wide, provide continuous head reinforcement for full width of opening, welded to back of frame at head.
6. Hardware Preparation: Factory prepare sound-control frames to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping, according to the Door Hardware Schedule and templates furnished as specified.

   a. Reinforce frames to receive nontemplated mortised and surface-mounted door hardware.
   b. Locate hardware as indicated, or if not indicated, according to NAAMM-HMMA 831, "Recommended Hardware Locations for Custom Hollow Metal Doors and Frames."

7. Plaster Guards: Weld guards to frame at back of hardware cutouts and glazing-stop screw and sound-control seal preparations to close off interior of openings in frames to be grouted.
8. Tolerances: Fabricate frames to tolerances indicated in ANSI/NAAMM-HMMA 865.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of sound-control door assemblies.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Prior to installation and with installation spreaders in place, adjust and securely brace sound-control door frames to the following tolerances:

1. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
2. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
3. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
4. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.

C. Drill and tap doors and frames to receive nontemplated mortised and surface-mounted door hardware.

3.3 INSTALLATION

A. General: Install sound-control door assemblies plumb, rigid, properly aligned, and securely fastened in place; comply with manufacturer's written instructions.

B. Frames: Install sound-control door frames in sizes and profiles indicated.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.

    a. At fire-rated openings, install frames according to NFPA 80.
    b. At openings requiring smoke and draft control, install frames according to NFPA 105.
    c. Where frames are fabricated in sections due to shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, and dress; make splice smooth, flush, and invisible on exposed faces.
    d. Install sound-control frames with removable glazing stops located on secure side of opening.
    e. Remove temporary braces only after frames or bucks have been properly set and secured.
    f. Check squareness, twist, and plumbness of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
    g. Apply corrosion-resistant coatings coating to backs of frames to be filled with mortar, grout, and plaster containing antifreezing agents.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor and secure with postinstalled expansion anchors.

    a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors, if so indicated and approved on Shop Drawings.

3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind frames.
4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
5. Concrete Walls: Solidly fill space between frames and concrete with grout. Take precautions, including bracing frames, to ensure that frames are not deformed or damaged by grout forces.
6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
7. In-Place Gypsum Board Partitions: Secure frames in place with postinstalled expansion anchors through floor anchors at each jamb. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
8. Ceiling Struts: Extend struts vertically from top of frame at each jamb to supporting construction above, unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction above. Provide adjustable wedged or bolted anchorage to frame jamb members.

9. Grouted Frames: Solidly fill space between frames and substrate with grout. Take precautions, including bracing frames, to ensure that frames are not deformed or damaged by grout forces.
10. Installation Tolerances: Adjust sound-control door frames for squareness, alignment, twist, and plumbness to the following tolerances:

    a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
    c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    d. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.

C. Doors: Fit sound-control doors accurately in frames, within clearances indicated below. Shim as necessary. Install doors to comply with manufacturer's written instructions, referenced quality standard, and as indicated.

    1. Fire-Rated Doors: Install fire-rated doors with clearances according to NFPA 80.

D. Sound-Control Seals: Where seals have been prefit and preinstalled in the factory and subsequently removed for shipping, reinstall seals and adjust according to manufacturer's written instructions.

E. Cam-Lift Hinges: Install hinges according to manufacturer's written instructions.

F. Thresholds: Set thresholds in full bed of sealant complying with requirements in Division 7 Section "Joint Sealants."

G. Glazing: Comply with installation requirements in Division 8 Section "Glazing" and with sound-control door assembly manufacturer's written instructions.

    1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c., and not more than 2 inches o.c. from each corner.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Testing Services: Acoustical testing and inspecting agency shall select three sound-control door(s) at random from sound-control door assemblies that are completely installed and perform testing for verification that assembly complies with STC rating requirements.

    1. Field tests shall be conducted according to ASTM E 336, with results calculated according to ASTM E 413. Acceptable field STC values shall be within 5 dB of laboratory STC values.
    2. Inspection Report: Acoustical testing agency shall submit report in writing to Design Professional and Construction Manager within 24 hours after testing.
    3. If tested door fails, replace or rework all sound-control door assemblies to bring them into compliance at Construction Manager’s expense.

a. Additional testing and inspecting, at Construction Manager's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

C. Prepare test and inspection reports.

3.5 ADJUSTING AND CLEANING

A. Final Adjustments: Check and adjust seals, door bottoms, and other sound-control hardware items right before final inspection. Leave work in complete and proper operating condition.

B. Remove and replace defective work, including defective or damaged sound seals and doors and frames that are warped, bowed, or otherwise unacceptable.

1. Adjust gaskets, gasket retainers, and retainer covers to provide contact required to achieve STC rating.

C. Clean grout off sound-control door frames immediately after installation.

D. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying primer.

E. Metallic-Coated Surfaces: Clean abraded areas of doors and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Exterior and interior manual-swing aluminum doors for installation in curtain wall framing.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 07 92 00 - JOINT SEALANTS for installation of joint sealants installed with aluminum-framed systems and for sealants to the extent not specified in this Section.
2. Section 08 44 10 - GLAZED ALUMINUM CURTAIN WALLS for door framing.
3. Section 08 71 00 - DOOR HARDWARE for lock cylinders and keying.
4. Section 08 71 13 - AUTIMATIC DOOR OPERATORS for door operators.
5. Section 08 80 00 - GLAZING for glazing requirements to the extent not specified in this Section.

1.3 PERFORMANCE REQUIREMENTS

A. General: Provide aluminum-framed systems, including anchorage, capable of withstanding, without failure, the effects of the following:

1. Structural loads.
2. Thermal movements.
3. Dimensional tolerances of building frame and other adjacent construction.
4. Failure includes the following:

   a. Deflection exceeding specified limits.
   b. Thermal stresses transferred to building structure.
   c. Framing members transferring stresses, including those caused by thermal and structural movements, to glazing.
   d. Noise or vibration created by wind and thermal and structural movements.
   e. Loosening or weakening of fasteners, attachments, and other components.
   f. Sealant failure.
   g. Failure of operating units to function properly.

B. Structural Loads: Wind and seismic loads as indicated on the Structural Drawings, but not less than that required by Code.

C. Deflection of Framing Members:

1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans up to 13 feet 6 inches (and to 1/240 of clear span plus 1/4 inch for spans greater than 13 feet 6 inches or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch, whichever is smaller, amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components directly below to less than 1/8 inch and clearance between members and operable units directly below to less than 1/16 inch.

D. Thermal Movements: Provide aluminum-framed systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

E. Air Infiltration Test: Test unit in accordance with ASTM E 283, as follows:

1. Static Air Pressure Difference: 1.567 psf for doors.
2. Performance: Maximum air leakage shall not exceed the following: glazed entrance door units, 0.3 cfm/sf of other areas.

F. Water Leakage Test: Test fixed framing system in accordance with ASTM E 331.

1. Test Pressure: 8 psf.
2. Performance: No leakage as defined in test method at specified test pressure. No uncontrolled water penetrating system or appearing on normally exposed interior surfaces.

G. Solar Heat-Gain Coefficient: Provide units with a whole-unit SHGC maximum as required by Code, determined according to NFRC 200 procedures. Submit proof of compliance with submittals as specified.

H. Condensation Resistance: Provide aluminum-framed systems with fixed glazing and framing areas having condensation-resistance factor (CRF) of not less than 48 for doors when tested according to AAMA 1503.

1.4 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of product indicated.

B. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.

1. Include structural analysis data signed and sealed by the qualified professional engineer registered in the jurisdiction where the Project is located, responsible for their preparation.
2. Include structural analysis of story drift and deflection from anticipated live loads, and determination whether head receptors are required.
3. Include details of provisions for system expansion and contraction and for draining moisture occurring within the system to the exterior.
4. For entrances, include hardware schedule and indicate operating hardware types, functions, quantities, and locations.

C. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

D. Qualification Data: For Installer.

E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for aluminum-framed systems.

F. Performance Reports: Based on systems, components and glazing methods proposed for use on this Project, proof that units as glazed for this Project meet or exceed Code requirements for the following:

1. U-value.
2. Solar heat-gain coefficient.

G. Maintenance Data: For aluminum-framed systems to include in maintenance manuals.

H. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Capable of assuming engineering responsibility and performing work of this Section and who is acceptable to manufacturer.

1. Engineering Responsibility: Preparation of data for aluminum-framed systems including Shop Drawings based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project and submission of reports of tests performed on manufacturer's standard assemblies.

B. Accessible Entrances: Comply with Massachusetts Architectural Access Board and the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of structural supports for aluminum-framed systems by field measurements before fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating aluminum-framed systems

without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of aluminum-framed entrances and storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Structural failures including, but not limited to, excessive deflection.
   b. Noise or vibration created by wind and thermal and structural movements.
   c. Deterioration of metals and other materials beyond normal weathering.
   d. Water penetration through fixed glazing and framing areas.
   e. Failure of operating components.
2. Warranty Period: 10 years from date of Substantial Completion.

B. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes fail within specified warranty period. Warranty does not include normal weathering.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Doors, Wide Stile:
   a. EFCO, a Pella Company.
   b. Kawneer North America.
   c. Oldcastle BuildingEnvelope.
   d. Tubelite Inc.
   e. TRACO.
   f. United States Aluminum Corp.
   g. YKK AP America Inc.

B. Basis-of-Design: 500 Heavy Wall with 12 inch bottom rail by Kawneer.

2.2 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

1. Sheet and Plate: ASTM B 209.
2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
3. Extruded Structural Pipe and Tubes: ASTM B 429.
4. Structural Profiles: ASTM B 308/B 308M.
5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.

B. Steel Reinforcement: With manufacturer's standard corrosion-resistant primer complying with SSPC-PS Guide No. 12.00 applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.

1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.3 FRAMING SYSTEMS

A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Construction: Thermal-break.
2. Subframe Construction: Provide manufacturer’s heavy wall construction.

B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
2. Reinforce members as required to receive fastener threads.
3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.

D. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.

E. Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials. Form exposed flashing from sheet aluminum finished to match framing and of sufficient thickness to maintain a flat appearance without visible deflection.

2.4 GLAZING SYSTEMS

A. Glazing: As specified in Section 08 80 00 - GLAZING.

B. Glazing Gaskets: Manufacturer's standard compression types, replaceable, molded or extruded, that maintain uniform pressure and watertight seal.

C. Spacers and Setting Blocks: Manufacturer's standard elastomeric types.

2.5 DOORS

A. Doors: Manufacturer's standard glazed doors, for manual swing operation.

1. Door Construction: Mechanical clip fastening, SIGMA deep penetration plus welds and 1-1/8 inch long fillet welds inside and outside of all four corners. Glazing stops shall be hook-in type and EPDM glazing gaskets reinforced with non-stretchable cord.

2.6 DOOR HARDWARE

A. General: Provide heavy-duty units in sizes and types recommended by entrance system and hardware manufacturers for entrances and uses indicated.

1. Opening-Force Requirements:

a. Egress Doors: Not more than 30 lbf required to set door in motion and not more than 15 lbf required to open door to minimum required width.
b. Accessible Interior Doors: Not more than 5 lbf.

B. Hardware Sets: Provide as specified in Section 08 71 00 - DOOR HARDWARE.

2.7 ACCESSORY MATERIALS

A. Insulating Materials: As specified in Section 07 21 00 - THERMAL INSULATION.

B. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Section 07 92 00 - JOINT SEALANTS.

C. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil thickness per coat.

2.8 FABRICATION

A. Form aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Door Frames: Reinforce as required to support loads imposed by door operation and for installing hardware.

1. At exterior doors, provide compression weather stripping at fixed stops.
2. At interior doors, provide silencers at stops to prevent metal-to-metal contact. Install three silencers on strike jamb of single-door frames and two silencers on head of frames for pairs of doors.

D. Doors: Reinforce doors as required for installing hardware.

1. At pairs of exterior doors, provide sliding weather stripping retained in adjustable strip mortised into door edge.
2. At exterior doors, provide weather sweeps applied to door bottoms.

E. Hardware Installation: Factory install hardware to the greatest extent possible. Cut, drill, and tap for factory-installed hardware before applying finishes.

F. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.9 ALUMINUM FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Fluoropolymer Two-Coat Finish System: Manufacturer's standard two-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color coat, with topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight, with a minimum total dry film thickness of 1.5 mil; complying with AAMA 2605.

1. Color and Gloss: Match Valspar Fluoropon Classic II, Champagne Gold, Pearlescent/Mica Fleck Finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
6. Seal joints watertight, unless otherwise indicated.

B. Metal Protection:

1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape or installing nonconductive spacers as recommended by manufacturer for this purpose.

2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components plumb and true in alignment with established lines and grades, without warp or rack.

D. Install glazing as specified in Section 08 80 00 - GLAZING.

E. Entrances: Install to produce smooth operation and tight fit at contact points.

1. Exterior Entrances: Install to produce tight fit at weather stripping and weathertight closure.
2. Field-Installed Hardware: Install surface-mounted hardware according to hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

F. Erection Tolerances: Install aluminum-framed systems to comply with the following maximum tolerances:

1. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet; 1/4 inch over total length.
2. Alignment:

a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch.
b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch.

3. Diagonal Measurements: Limit difference between diagonal measurement to 1/8 inch.

3.3 ADJUSTING

A. Entrances: Adjust operating hardware for smooth operation according to hardware manufacturers' written instructions.

1. For doors accessible to people with disabilities, adjust closers to provide a 3-second closer sweep period for doors to move from a 70-degree open position to 3 inches from the latch measured to the leading door edge.

END OF SECTION 08 41 13

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Interior and exterior glazed aluminum-framed curtain wall systems.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 07 84 10 - PENETRATION FIRESTOPPING for perimeter fire-containment systems (safing insulation) field installed with glazed aluminum curtainwall systems.
2. Section 07 92 00 - JOINT SEALANTS for installation of joint sealants installed with glazed aluminum curtain-wall systems and for sealants to the extent not specified in this Section.
3. Section 08 41 13 - ALUMINUM-FRAMED ENTRANCES for entrance systems.
4. Section 08 51 10 - ALUMINUM WINDOWS for windows.
5. Section 08 80 00 - GLAZING for glass and glazing of aluminum curtainwall systems.
6. Section 08 90 00 - LOUVERS AND VENTS for units installed with glazed aluminum curtainwall systems.
7. Section 10 71 10 - SUN CONTROL DEVICES for interior and exterior sun control attached to curtain wall system.

1.3 PERFORMANCE REQUIREMENTS

A. General: Provide glazed aluminum curtain-wall systems, including anchorage, capable of withstanding, without failure, the effects of the following:

1. Structural loads.
2. Thermal movements.
3. Movements of supporting structure indicated on Drawings including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
4. Dimensional tolerances of building frame and other adjacent construction.
5. Failure includes the following:

a. Deflection exceeding specified limits.
b. Thermal stresses transferred to building structure.
c. Framing members transferring stresses, including those caused by thermal and structural movements, to glazing.
d. Noise or vibration created by wind and thermal and structural movements.
e. Loosening or weakening of fasteners, attachments, and other components.
f. Sealant failure.

B. Structural Loads: Wind and seismic loads as indicated on the Structural Drawings, but not less than that required by Code.

C. Structural-Test Performance: Provide glazed aluminum curtain-wall systems tested according to ASTM E 330 as follows:

1. When tested at positive and negative wind-load design pressures, systems do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Duration: As required by design wind velocity but not less than 10 seconds.

D. Deflection of Framing Members:

1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans up to 13 feet 6 inches, and to 1/240 of clear span plus 1/4 inch for spans greater than 13 feet 6 inches or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch, whichever is smaller, amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch.

E. Story Drift: Provide glazed aluminum curtain-wall systems that accommodate design displacement of adjacent stories indicated.

1. Design Displacement: As indicated on Drawings.
2. Test Performance: No glass breakage, anchor failures, or structural damage when tested according to AAMA 501.4.

F. Thermal Movements: Provide glazed aluminum curtain-wall systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

G. Air Infiltration: Provide glazed aluminum curtain-wall systems with maximum air leakage of 0.06 cfm/sq. ft. of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure differential of 6.24 lbf/sq. ft.

H. Water Penetration Under Static Pressure: Provide aluminum glazed curtain-wall systems that do not evidence water penetration when tested according to ASTM E 331 at a minimum

differential static pressure of 20 percent of positive design wind load, but not less than 12 lbf/sq. ft.

1. Maximum Water Leakage: No uncontrolled water penetrating systems or appearing on systems' normally exposed interior surfaces from sources other than condensation. Water controlled by flashing and gutters that is drained to exterior and cannot damage adjacent materials or finishes is not considered water leakage.

I. Condensation Resistance: Provide glazed aluminum curtain-wall systems with condensation-resistance factor (CRF) of not less than 76 at glass and 79 at frame when tested according to AAMA 1503.

J. Solar Heat-Gain Coefficient: Provide units with a whole-unit SHGC maximum as required by Code, determined according to NFRC 200 procedures. Submit proof of compliance with submittals as specified.

K. Thermal Transmittance: Provide window units that have a U-value not greater than 0.33 rated in BTU/hour/sq. ft./degrees F at 15-mph exterior wind velocity, when tested in accordance with AAMA 1503.1. Test unit to be 4 ft. x 6 ft. Submit proof of compliance with submittals as specified.

1.4 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of product indicated.

B. Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication and assembly of glazed aluminum curtain-wall systems.

1. Include structural analysis data signed and sealed by the qualified professional engineer licensed in the state the project is located, responsible for their preparation.
2. Include structural analysis of story drift and deflection from anticipated live loads, and determination whether head receptors are required.

C. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

D. Fabrication Sample: Of each vertical-to-horizontal intersection of systems, made from 12-inch lengths of full-size components and showing details of the following:

1. Joinery.
2. Anchorage.
3. Expansion provisions.
4. Glazing.
5. Flashing and drainage.

E. Performance Reports: Based on systems, components and glazing methods proposed for use on this Project, proof that units as glazed for this Project meet or exceed Code requirements for the following:

1. U-value.
2. Solar heat-gain coefficient.

F. Welding certificates.

G. Qualification data for Installer.

H. Field quality-control test reports.

I. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Capable of assuming engineering responsibility and performing Work of this Section and who is acceptable to manufacturer.

B. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a qualified professional engineer.

C. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the state the project is located, and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of curtain wall framing that are similar to those indicated for this Project in material, design, and extent.

D. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field-testing, and in-service performance.

E. Welding: Qualify procedures and personnel according to AWS D1.2, "Structural Welding Code--Aluminum."

F. Installation Sequence Conference: Conduct conference at Project site to review sequence of installation of curtain wall systems, including installation of joint sealants, flashing, and glass. Conference shall be attended by all installers of applicable components.

G. Mockups: Build mockups to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical wall area as indicated on Drawings.
2. Build mockup in sequence recommended by manufacturer including installation of joint sealants, flashing and glass.
3. The construction of the mockup shall be observed by all tradesmen constructing the curtain wall system.

H. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01. Review methods and procedures related to glazed aluminum curtain-wall systems including, but not limited to, the following:

1. Review structural load limitations.
2. Review installation sequence, including installation of sealants, flashing, and glass.

3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review required testing, inspecting, and certifying procedures.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of structural supports for glazed aluminum curtain-wall systems by field measurements before fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating glazed aluminum curtain-wall systems without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.7 WARRANTY

A. Special Assembly Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of glazed aluminum curtain-wall systems that do not comply with requirements or that deteriorate as defined in this Section within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including, but not limited to, excessive deflection.
b. Noise or vibration caused by thermal movements.
c. Deterioration of metals and other materials beyond normal weathering.
d. Water leakage.
e. Failure of operating components to function normally.

2. Warranty Period: Five years from date of Substantial Completion.

B. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes fail within specified warranty period. Warranty does not include normal weathering.

1. Warranty Period: Ten years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Curtainwall System:
a. EFCO, a Pella Company.
b. Kawneer North America.
c. Tubelite Inc.
d. TRACO.
e. United States Aluminum.
f. Wausau.

g. YKK AP America Inc.

B. Basis-of-Design – Exterior Systems: Series 1600UT System 1 and System 2 by Kawneer.

C. Basis-of-Design – Interior Systems: Series 1600 System 1 and System 4 by Kawneer.

2.2 FRAMING SYSTEMS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

1. Sheet and Plate: ASTM B 209
2. Extruded Bars, Rods, Shapes, and Tubes: ASTM B 221
3. Extruded Structural Pipe and Tubes: ASTM B 429.

B. Steel Reinforcement: With manufacturer's standard corrosion-resistant primer complying with SSPC-PS Guide No. 12.00 applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.

1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
2. Cold-Rolled Sheet and Strip: ASTM A 611.
3. Hot-Rolled Sheet and Strip: ASTM A 570/A 570M.

C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

D. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Where fasteners are subject to loosening or turn out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
2. Reinforce members as required to receive fastener threads.
3. Where acceptable, use exposed fasteners with countersunk Phillips screw heads.
4. Finish exposed portions to match framing system.
5. At movement joints, use slip-joint linings, spacers, and sleeves of material and type recommended by manufacturer.

E. Anchors: Three-way adjustable anchors that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.

1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.

F. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

G. Framing Sealants: As recommended by manufacturer for joint type.

2.3 GLAZING SYSTEMS

A. Glazing: As specified in Section 08 80 00 - GLAZING.

2.4 ACCESSORY MATERIALS

A. Perimeter Fire-Containment Systems (Safing Insulation): Specified in Section 07 84 10 - PENETRATION FIRESTOPPING.

B. Insulating Materials: Specified in Section 07 21 00 - THERMAL INSULATION.

C. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil thickness per coat.

2.5 FABRICATION

A. Form aluminum shapes before finishing.

B. Fabricate components that, when assembled, have the following characteristics:

1. Sharp profiles, straight and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Internal guttering systems or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
4. Physical and thermal isolation of glazing from framing members.
5. Accommodations for thermal and mechanical movements of glazing and framing to prevent glazing-to-glazing contact and to maintain required glazing edge clearances.

C. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

D. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.6 ALUMINUM FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Fluoropolymer Two-Coat Finish System: Manufacturer's standard two-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color coat, with

topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight, with a minimum total dry film thickness of 1.5 mil; complying with AAMA 2605.

1. Color and Gloss: Match Valspar Fluoropon Classic II, Champagne Gold, Pearlescent/Mica Fleck Finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
6. Seal joints watertight, unless otherwise indicated.

B. Metal Protection:

1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape or installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.

D. Install components plumb and true in alignment with established lines and grades.

E. Coordinate with glazing and installation of glazing which is specified in Section 08 80 00 - GLAZING.

F. Coordinate with sealants and installation of perimeter sealants which is specified in Section 07 92 00 - JOINT SEALANTS.

G. Coordinate with insulation and installation of insulation which is specified in Section 07 21 00 - THERMAL INSULATION.

H. Coordinate with materials and installation for perimeter fire-containment systems (safing insulation) which is specified in Section 07 84 40 - FIRE-RESISTIVE JOINT SYSTEMS.

I. Erection Tolerances: Install glazed aluminum curtain-wall systems to comply with the following maximum tolerances:

1. Plumb: 1/8 inch in 10 feet ; 1/4 inch in 40 feet.
2. Level: 1/8 inch in 20 feet ; 1/4 inch in 40 feet.
3. Alignment:

   a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch wide, limit offset from true alignment to 1/16 inch.
   b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch.
   c. Where surfaces are separated by reveal or protruding element of 1 inch wide or greater, limit offset from true alignment to 1/4 inch.

4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing Services: Testing and inspecting of representative areas to determine compliance of installed system with specified requirements shall take place as follows and in successive stages as indicated on Drawings. Do not proceed with installation of the next area until test results for previously completed areas show compliance with requirements.

1. Air Infiltration: Areas shall be tested for air leakage of 1.5 times the rate specified under Part 1 "Performance Requirements" Article, but not more than 0.09 cfm/sq. ft. of fixed wall area when tested according to ASTM E 783 at a minimum static-air-pressure differential of 8 lbf/sq. ft.
2. Water Penetration: Areas shall be tested according to ASTM E 1105 at minimum cyclic static-air-pressure difference of 0.67 times the pressure specified under Part 1 "Performance Requirements" Article, but not less than 8 lbf/sq. ft. and shall not evidence water penetration.
3. Water Spray Test: After the installation of minimum area of 75-feet-by-2-story glazed aluminum curtain-wall system has been completed but before installation of interior finishes has begun, a 2-bay area of system designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.

C. Repair or remove work where test results and inspections indicate that it does not comply with specified requirements.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

END OF SECTION 08 44 10

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Interior and exterior fire-rated glazed steel-framed curtain wall system and doors.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and will be performed under the designated Sections:

1. Section 07 84 13 - PENETRATION FIRESTOPPING for perimeter fire-containment systems (safing insulation) field installed with glazed curtainwall systems.
2. Section 07 92 00 - JOINT SEALANTS for installation of joint sealants installed with glazed curtain-wall systems and for sealants to the extent not specified in this Section.
3. Section 08 80 00 - GLAZING for fire-rated glass and glazing of curtainwall systems.
4. Section 08 90 00 - LOUVERS AND VENTS for units installed with glazed curtainwall systems.

1.3 PERFORMANCE REQUIREMENTS

A. General: Provide fire-rated glazed steel curtain-wall systems, including anchorage, capable of withstanding, without failure, the effects of the following:

1. Structural loads.
2. Thermal movements.
3. Movements of supporting structure indicated on Drawings including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
4. Dimensional tolerances of building frame and other adjacent construction.
5. Failure includes the following:

a. Deflection exceeding specified limits.
b. Thermal stresses transferred to building structure.
c. Framing members transferring stresses, including those caused by thermal and structural movements, to glazing.
d. Noise or vibration created by wind and thermal and structural movements.
e. Loosening or weakening of fasteners, attachments, and other components.

f. Sealant failure.

B. Structural Loads: Wind and seismic loads as indicated on the Structural Drawings, but not less than that required by Code.

C. Structural-Test Performance: Provide fire-rated glazed steel curtain-wall systems tested according to ASTM E 330 as follows:

1. When tested at positive and negative wind-load design pressures, systems do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Duration: As required by design wind velocity but not less than 10 seconds.

D. Deflection of Framing Members:

1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans up to 13 feet 6 inches, and to 1/240 of clear span plus 1/4 inch for spans greater than 13 feet 6 inches or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch, whichever is smaller, amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch.

E. Story Drift: Provide fire-rated glazed steel curtain-wall systems that accommodate design displacement of adjacent stories indicated.

1. Design Displacement: As indicated on Drawings.
2. Test Performance: No glass breakage, anchor failures, or structural damage when tested according to AAMA 501.4.

F. Thermal Movements: Provide fire-rated glazed steel curtain-wall systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

G. Air Infiltration: Provide fire-rated glazed steel curtain-wall systems with maximum air leakage of 0.06 cfm/sq. ft. of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure differential of 6.24 lbf/sq. ft.

H. Water Penetration Under Static Pressure: Provide fire-rated glazed steel curtain-wall systems that do not evidence water penetration when tested according to ASTM E 331 at a minimum differential static pressure of 20 percent of positive design wind load, but not less than 10 lbf/sq. ft.

1. Maximum Water Leakage: No uncontrolled water penetrating systems or appearing on systems' normally exposed interior surfaces from sources other than condensation.

Water controlled by flashing and gutters that is drained to exterior and cannot damage adjacent materials or finishes is not considered water leakage.

I. Condensation Resistance: Provide fire-rated glazed steel curtain-wall systems with condensation-resistance factor (CRF) of not less than 55 when tested according to AAMA 1503.

J. Solar Heat-Gain Coefficient: Provide units with a whole-unit SHGC maximum as required by Code, determined according to NFRC 200 procedures. Submit proof of compliance with submittals as specified.

K. Thermal Transmittance: Provide window units that have a U-value as required by Code rated in BTU/hour/sq. ft./degrees F at 15-mph exterior wind velocity, when tested in accordance with AAMA 1503.1. Test unit to be 4 ft. x 6 ft. Submit proof of compliance with submittals as specified.

1.4 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of product indicated.

B. LEED Submittal:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of post-consumer and pre-consumer recycled content.

a. Include statement indicating costs for each product having recycled content.

2. Product Data for Credit MR 5: For products having regional materials, documentation indicating percentages of building materials and products that have been extracted, harvested or recovered, as well as manufactured, within 500 miles of the project site.

a. Include statement indicating costs for each product having regional materials.

3. Product Data for Credit IEQ 4.1: For interior adhesives and sealants applied inside the weatherproofing system and applied on-site, including printed statement of VOC content.

C. Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication and assembly of fire-rated glazed steel curtain-wall systems.

1. Include structural analysis data signed and sealed by the qualified professional engineer licensed in the jurisdiction where the Project is located responsible for their preparation.
2. Include structural analysis of story drift and deflection from anticipated live loads, and determination whether head receptors are required.

D. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

E. Fabrication Sample: Of each vertical-to-horizontal intersection of systems, made from 12-inch lengths of full-size components and showing details of the following:

1. Joinery.
2. Anchorage.

3. Expansion provisions.
4. Glazing.
5. Flashing and drainage.

F. Performance Reports: Based on systems, components and glazing methods proposed for use on this Project, proof that units as glazed for this Project meet or exceed Code requirements for the following:

1. U-value.
2. Solar heat-gain coefficient.

G. Welding certificates.

H. Qualification data for Installer.

I. Field quality-control test reports.

J. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Capable of assuming engineering responsibility and performing Work of this Section and who is acceptable to manufacturer.

B. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a qualified professional engineer.

C. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the jurisdiction where the Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of curtain wall framing that are similar to those indicated for this Project in material, design, and extent.

D. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field-testing, and in-service performance.

E. Welding: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code—Sheet Steel"

F. Mockups: Build mockups to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical wall area as shown on Drawings.

G. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01. Review methods and procedures related to fire-rated glazed steel curtain-wall systems including, but not limited to, the following:

1. Review structural load limitations.
2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review required testing, inspecting, and certifying procedures.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of structural supports for fire-rated glazed steel curtain-wall systems by field measurements before fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating fire-rated glazed steel curtain-wall systems without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.7 WARRANTY

A. Special Assembly Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of fire-rated glazed steel curtain-wall systems that do not comply with requirements or that deteriorate as defined in this Section within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including, but not limited to, excessive deflection.
b. Noise or vibration caused by thermal movements.
c. Deterioration of metals and other materials beyond normal weathering.
d. Water leakage.
e. Failure of operating components to function normally.

2. Warranty Period: Five years from date of Substantial Completion.

B. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes fail within specified warranty period. Warranty does not include normal weathering.

1. Warranty Period: Ten years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Basis-of-Design: Technical Glass Products; Fireframes Curtainwall Series; 60 mm.
2. Forster AG; Thermfix Vario.

2.2 FRAMING SYSTEMS

A. Fire-Rated Steel Curtainwall Framing System: Provide systems per required rating as indicated on the Architectural Code Plans.

1. Steel Frame: Profiled steel tubing permanently joined with steel bolts.
2. Steel Pressure Plates: Formed stainless steel pressure plate with dimensions recommended by manufacturer to securely hold glazing material in place.
3. Cover Caps: Formed extruded aluminum.

B. Steel Reinforcement: With manufacturer's standard corrosion-resistant primer complying with SSPC-PS Guide No. 12.00 applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.

1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
2. Cold-Rolled Sheet and Strip: ASTM A 611.
3. Hot-Rolled Sheet and Strip: ASTM A 570/A 570M.

C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

D. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Where fasteners are subject to loosening or turn out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
2. Reinforce members as required to receive fastener threads.
3. Where acceptable, use exposed fasteners with countersunk Phillips screw heads.
4. Finish exposed portions to match framing system.
5. At movement joints, use slip-joint linings, spacers, and sleeves of material and type recommended by manufacturer.

E. Anchors: Three-way adjustable anchors that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.

1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.

F. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

G. Framing Sealants: As recommended by manufacturer for joint type.

2.3 GLAZING SYSTEMS

A. Fire-Rated Glass and Glazing: Specified in Section 08 80 00 - GLAZING.

2.4 GLAZING SYSTEMS

A. Glazing: As specified in Section 088000 - GLAZING.

B. Glazing Gaskets: Manufacturer's standard compression types, replaceable, molded or extruded, that maintain uniform pressure and watertight seal.

C. Spacers and Setting Blocks: Manufacturer's standard elastomeric types.

2.5 DOORS

A. Doors: Manufacturer's 90-minute fire-rated glazed doors, for manual swing operation.

1. Door Construction: Mechanical clip fastening, SIGMA deep penetration plus welds and 1-1/8 inch long fillet welds inside and outside of all four corners. Glazing stops shall be hook-in type and EPDM glazing gaskets reinforced with non-stretchable cord.

2.6 DOOR HARDWARE

A. General: Provide heavy-duty units in sizes and types recommended by entrance system and hardware manufacturers for entrances and uses indicated.

1. Opening-Force Requirements:

a. Egress Doors: Not more than 30 lbf required to set door in motion and not more than 15 lbf required to open door to minimum required width.
b. Accessible Interior Doors: Not more than 5 lbf.

B. Hardware Sets: Provide as specified in Section 087100 - DOOR HARDWARE.

2.7 INSULATED SPANDREL PANELS

A. Insulated Spandrel Panels: Laminated, metal-faced flat panels with no deviations in plane exceeding 0.8 percent of panel dimension in width or length.

1. Overall Panel Thickness: 1 inch .
2. Exterior and Interior Skin: Aluminum.

a. Thickness: Manufacturer's standard for finish and texture indicated.
b. Finish: Matching framing system.
c. Texture: Smooth.
d. Backing Sheet: Manufacturer's standard.
e. Thermal Insulation Core: Manufacturer's standard..

2.8 ACCESSORY MATERIALS

A. Perimeter Fire-Containment Systems (Safing Insulation): Specified in Section 07 84 00 - FIRESTOPPING.

B. Insulating Materials: Specified in Section 072100 - THERMAL INSULATION.

C. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil thickness per coat.

2.9 FABRICATION

A. Form aluminum and steel shapes before finishing.

B. Fabricate components that, when assembled, have the following characteristics:

1. Sharp profiles, straight and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Internal guttering systems or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
4. Physical and thermal isolation of glazing from framing members.
5. Accommodations for thermal and mechanical movements of glazing and framing to prevent glazing-to-glazing contact and to maintain required glazing edge clearances.

C. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

D. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.10 STEEL FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Fluoropolymer Two-Coat Finish System: Manufacturer's standard two-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color coat, with topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight, with a minimum total dry film thickness of 1.5 mil; complying with AAMA 2605.

1. Color and Gloss: Match Valspar Fluoropon Classic II, Champagne Gold, Pearlescent/Mica Fleck Finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
6. Seal joints watertight, unless otherwise indicated.

B. Metal Protection:

1. Where aluminum and steel will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape or installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum and steel will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.

D. Install components plumb and true in alignment with established lines and grades.

E. Coordinate with glazing and installation of glazing which is specified in Section 08 80 00 - GLAZING.

F. Coordinate with sealants and installation of perimeter sealants which is specified in Section 07 92 00 - JOINT SEALANTS.

G. Coordinate with insulation and installation of insulation which is specified in Section 07 21 00 - THERMAL INSULATION.

H. Coordinate with materials and installation for perimeter fire-containment systems (safing insulation) which is specified in Section 07 84 40 - FIRE-RESISTIVE JOINT SYSTEMS.

I. Erection Tolerances: Install fire-rated glazed steel curtain-wall systems to comply with the following maximum tolerances:

1. Plumb: 1/8 inch in 10 feet ; 1/4 inch in 40 feet.
2. Level: 1/8 inch in 20 feet ; 1/4 inch in 40 feet.
3. Alignment:

   a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch wide, limit offset from true alignment to 1/16 inch.
   b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch.
   c. Where surfaces are separated by reveal or protruding element of 1 inch wide or greater, limit offset from true alignment to 1/4 inch.

4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing Services: Testing and inspecting of representative areas to determine compliance of installed system with specified requirements shall take place as follows and in successive stages as indicated on Drawings. Do not proceed with installation of the next area until test results for previously completed areas show compliance with requirements.

1. Air Infiltration: Areas shall be tested for air leakage of 1.5 times the rate specified under Part 1 "Performance Requirements" Article, but not more than 0.09 cfm/sq. ft. of fixed wall area when tested according to ASTM E 783 at a minimum static-air-pressure differential of 8 lbf/sq. ft.
2. Water Penetration: Areas shall be tested according to ASTM E 1105 at minimum cyclic static-air-pressure difference of 0.67 times the pressure specified under Part 1 "Performance Requirements" Article, but not less than 8 lbf/sq. ft. and shall not evidence water penetration.
3. Water Spray Test: After the installation of minimum area of 75-feet-by-2-story fire-rated glazed steel curtain-wall system has been completed but before installation of interior finishes has begun, a 2-bay area of system designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.

C. Repair or remove work where test results and inspections indicate that it does not comply with specified requirements.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

END OF SECTION 08 44 16

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Fixed aluminum-framed windows with factory-installed glass and glazing.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 08 41 10 - ALUMINUM-FRAMED ENTRANCES.
2. Section 08 44 10 - GLAZED ALUMINUM CURTAIN WALLS for curtain wall assemblies.
3. Section 08 80 00 - GLAZING for requirements for glass and glazing.

1.3 PERFORMANCE REQUIREMENTS

A. General: Provide aluminum windows capable of complying with performance requirements indicated, based on testing manufacturer's windows that are representative of those specified and that are of test size indicated below:

1. Minimum size required by AAMA/NWWDA 101/I.S.2.

B. AAMA/NWWDA Performance Requirements: Provide aluminum windows of the performance class and grade indicated that comply with AAMA/NWWDA 101/I.S.2.

1. Performance Class: Architectural Grade AW.
2. Performance Grade: Minimum for performance class indicated.
3. Exception to AAMA/NWWDA 101/I.S.2: In addition to requirements for performance class and performance grade, design glass framing system to limit lateral deflections of glass edges to less than 1/175 of glass-edge length or 3/4 inch whichever is less, at design pressure based on the following:

C. Structural Performance: Provide aluminum windows capable of withstanding the following, including wind loads based on passing AAMA/NWWDA 101/I.S.2, Uniform Load Structural Test, at basic wind speed indicated and as required by Code:

1. Deflection: Design glass framing system to limit lateral deflections of glass edges to less than 1/175 of glass-edge length or 3/4 inch, whichever is less, at design pressure based on structural computations.
2. Wind and Seismic Loads: As indicated on the Structural Drawings, but not less than that required by Code.
3. Movements of supporting structure including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads as required by Code. Deflection may require special considerations including but not limited to head receptors.

D. Air Infiltration: Maximum rate not more than indicated when tested according to AAMA/NWWDA 101/I.S.2, Air Infiltration Test.

1. Maximum Rate: As required by Code.

E. Water Resistance: No water leakage as defined in AAMA/NWWDA referenced test methods at a water test pressure equaling that indicated, when tested according to AAMA/NWWDA 101/I.S.2, Water Resistance Test.

1. Test Pressure: 15 percent of positive design pressure, but not less than 8 lbf/sq. ft.

F. Condensation-Resistance Factor: Provide aluminum windows tested for thermal performance according to AAMA 1503, showing a CRF of 52 where windows are indicated to be "thermally improved."

G. Thermal Transmittance: Provide aluminum windows with a whole-window U-value maximum indicated at 15-mph exterior wind velocity and winter condition temperatures when tested according to AAMA 1503.

1. U-Value: As required by Code. Submit proof of compliance with submittals as specified.

H. Solar Heat-Gain Coefficient: Provide aluminum windows with a whole-window SHGC maximum as required by Code, determined according to NFRC 200 procedures. Submit proof of compliance with submittals as specified.

I. Thermal Movements: Provide aluminum windows, including anchorage, that accommodate thermal movements of units resulting from the following maximum change (range) in ambient and surface temperatures without buckling, distortion, opening of joints, failure of joint sealants, damaging loads and stresses on glazing and connections, and other detrimental effects. Base engineering calculation on actual surface temperatures of materials due to solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F material surfaces.

1.4 SUBMITTALS

A. Product Data: Include construction details, material descriptions, fabrication methods, dimensions of individual components and profiles, hardware, finishes, and operating instructions for each type of aluminum window indicated.

B. Shop Drawings: Include plans, elevations, sections, details, hardware, attachments to other Work, operational clearances, and the following:

1. Mullion details, including reinforcement and stiffeners.
2. Joinery details.
3. Expansion provisions.
4. Flashing and drainage details.
5. Weather-stripping details.
6. Thermal-break details.
7. Glazing details.
8. Window cleaning provisions.
9. Window System Operators: Show locations, mounting, and details for installing operator components and controls.
10. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation and used to determine the following:

    a. Structural test pressures and design pressures from basic wind speeds indicated.
    b. Deflection limitations of glass framing systems.

C. Samples for Verification: Full-size operable window of each type of window.

D. Qualification Data: For Installer, professional engineer and testing agency.

E. Field Quality-Control Test Reports: From a qualified testing and inspecting agency engaged by Contractor.

F. Product Test Reports: Based on evaluation of comprehensive tests performed within the last four years by a qualified testing agency, for each type, grade, and size of aluminum window. Test results based on use of downsized test units will not be accepted.

G. Performance Reports: Based on systems, components and glazing methods proposed for use on this Project, proof that windows as glazed for this Project meet or exceed Code requirements for the following:

    1. U-value.
    2. Solar heat-gain coefficient.

H. Maintenance Data: For operable window sash, operating hardware, weather stripping, and finishes to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An installer acceptable to aluminum window manufacturer for installation of units required for this Project.

B. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a qualified professional engineer.

C. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the state the project is located, and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of windows that are similar to those indicated for this Project in material, design, and extent.

D. Source Limitations: Obtain aluminum windows through one source from a single manufacturer.

E. Product Options: Information on Drawings and in Specifications establishes requirements for aluminum windows' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.

F. Fenestration Standard: Comply with AAMA/NWWDA 101/I.S.2, "Voluntary Specifications for Aluminum, Vinyl (PVC) and Wood Windows and Glass Doors," for minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.

1. Provide AAMA certified aluminum windows with an attached label.

G. Glazing Publications: Comply with published recommendations of glass manufacturers and GANA's "Glazing Manual" unless more stringent requirements are indicated.

H. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockup for types of windows indicated, in locations shown on Drawings.

I. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01. Review methods and procedures related to aluminum windows including, but not limited to, the following:

1. Inspect and discuss condition of substrate and other preparatory work performed by other trades.
2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review required testing and inspecting procedures.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify aluminum window openings by field measurements before fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating aluminum windows without field measurements. Coordinate wall construction to ensure that actual opening dimensions correspond to established dimensions.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, the following:

1. Failure to meet performance requirements.
2. Structural failures including excessive deflection.
3. Water leakage, air infiltration, or condensation.
4. Faulty operation of movable sash and hardware.

5. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
6. Insulting glass failure.

B. Warranty Period: Ten years from date of Substantial Completion.

C. Warranty Period for Metal Finishes: Ten years from date of Substantial Completion.

D. Warranty Period for Glass: Ten years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Aluminum Windows:

a. Custom Window Company.
b. EFCO, a Pella Company.
c. Graham Architectural Products Corp.
d. Kawneer North America.
e. Mannix; a Division of Interstate Window Corp.
f. Oldcastle BuildingEnvelope.
g. Peerless Products, Inc.
h. Wausau.

B. Basis-of-Design: Series 5525 ISOWEB by Kawneer

2.2 MATERIALS

A. Aluminum Extrusions: Alloy and temper recommended by aluminum window manufacturer for strength, corrosion resistance, and application of required finish, but not less than 22,000-psi (150-MPa) ultimate tensile strength, not less than 16,000-psi (110-MPa) minimum yield strength, and not less than 0.062-inch (1.6-mm) thickness at any location for the main frame and sash members.

B. Fasteners: Aluminum, nonmagnetic stainless steel, epoxy adhesive, or other materials warranted by manufacturer to be noncorrosive and compatible with aluminum window members, trim, hardware, anchors, and other components.

1. Reinforcement: Where fasteners screw anchor into aluminum less than 0.125 inch (3.2 mm) thick, reinforce interior with aluminum or nonmagnetic stainless steel to receive screw threads, or provide standard, noncorrosive, pressed-in, splined grommet nuts.
2. Exposed Fasteners: Unless unavoidable for applying hardware, do not use exposed fasteners. For application of hardware, use fasteners that match finish of member or hardware being fastened, as appropriate.

C. Anchors, Clips, and Accessories: Aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.

D. Reinforcing Members: Aluminum, nonmagnetic stainless steel, or nickel/chrome-plated steel complying with ASTM B 456 for Type SC 3 severe service conditions, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.

E. Compression-Type Weather Stripping, typical: Provide compressible weather stripping designed for permanently resilient sealing under bumper or wiper action and for complete concealment when aluminum window is closed.

F. Sliding-Type Weather Stripping for Double-Hung and Horizontal-Sliding Windows: Provide woven-pile weather stripping of wool, polypropylene, or nylon pile and resin-impregnated backing fabric. Comply with AAMA 701/702.

1. Weather Seals: Provide weather stripping with integral barrier fin or fins of semirigid, polypropylene sheet or polypropylene-coated material. Comply with AAMA 701/702.

G. Replaceable Weather Seals: Comply with AAMA 701/702.

H. Sealant: For sealants required within fabricated windows, provide window manufacturer's standard, permanently elastic, nonshrinking, and nonmigrating type recommended by sealant manufacturer for joint size and movement.

2.3 GLAZING

A. Insulating-Glass Units for Vertical Glazing: 1 inch thick insulating glass consisting of two lites of 1/4 inch glass, low e coating on the No. 2 surface and argon gas filled. Provide one of the following or equal:
1. Basis-of-Design: Solarban 70XL by PPG Industries with laminated exterior lites.

B. Glazing System: Manufacturer's standard factory-glazing system that produces weathertight seal.

2.4 ACCESSORIES

A. Window Cleaner Anchor Bolts: Provide window cleaner anchor bolts of standard design, complying with requirements of authorities having jurisdiction. Fabricate bolts of nonmagnetic stainless steel.

1. Reinforce window units or mullions to receive bolts and provide additional anchorage of units at bolt locations.

2.5 FABRICATION

A. General: Fabricate aluminum windows, in sizes indicated, that comply with AAMA/NWWDA 101/I.S.2 for performance class and performance grade indicated. Include a complete system for assembling components and anchoring windows.

B. Thermally Improved Construction: Fabricate aluminum windows with an integral, concealed, low-conductance thermal barrier; located between exterior materials and window members exposed on interior side; in a manner that eliminates direct metal-to-metal contact.

C. Weep Holes: Provide concealed weep holes and internal passages to conduct infiltrating water to exterior.

D. Mullions: Provide mullions and cover plates as shown, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections, as indicated. Provide mullions and cover plates capable of withstanding design loads of window units.

E. Factory-Glazed Fabrication: Glaze aluminum windows in the factory where practical and possible for applications indicated. Comply with AAMA/NWWDA 101/I.S.2.

2.6 FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Fluoropolymer Two-Coat Finish System: Manufacturer's standard two-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color coat, with topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight, with a minimum total dry film thickness of 1.5 mil; complying with AAMA 2605.

1. Color and Gloss: Match Valspar Fluoropon Classic II, Champagne Gold, Pearlescent/Mica Fleck Finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances; rough opening dimensions; levelness of sill plate; coordination with wall flashings, vapor retarders, and other built-in components; operational clearances; and other conditions affecting performance of work.

1. Masonry Surfaces: Visibly dry and free of excess mortar, sand, and other construction debris.
2. Metal Surfaces: Dry; clean; free of grease, oil, dirt, rust, corrosion, and welding slag; without sharp edges or offsets at joints.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components; Drawings; and Shop Drawings.

B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction.

C. Set sill members in bed of sealant or with gaskets, as indicated, for weathertight construction.

D. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.

E. Metal Protection: Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials by complying with requirements specified in "Dissimilar Materials" Paragraph in Appendix B in AAMA/NWWDA 101/I.S.2.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and to prepare test reports.

B. Testing Services: Testing and inspecting of installed windows shall take place as follows:

1. Testing Methodology: Testing of windows for air infiltration and water resistance shall be performed according to AAMA 502, Test Method A, by applying same test pressures required to determine compliance with AAMA/NWWDA 101/I.S.2 in Part 1 "Performance Requirements" Article.
2. Testing Extent: Three windows as selected by Architect and a qualified independent testing and inspecting agency. Windows shall be tested immediately after installation.
3. Test Reports: Shall be prepared according to AAMA 502.

C. Remove and replace windows where test results indicate that they do not comply with specified requirements.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.4 ADJUSTING

A. Adjust operating sashes and ventilators, screens, hardware, operators, and accessories for a tight fit at contact points and weather stripping for smooth operation and weathertight closure. Lubricate hardware and moving parts.

3.5 PROTECTION AND CLEANING

A. Protect window surfaces from contact with contaminating substances resulting from construction operations. In addition, monitor window surfaces adjacent to and below exterior concrete and masonry surfaces during construction for presence of dirt, scum, alkaline deposits, stains, or other contaminants. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written recommendations.

B. Clean aluminum surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.

C. Clean factory-glazed glass immediately after installing windows. Comply with manufacturer's written recommendations for final cleaning and maintenance. Remove nonpermanent labels and clean surfaces.

D. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

END OF SECTION 08 51 10

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Aluminum-framed skylights with glass retained by field-installed pressure caps on four sides.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 07 62 00 - SHEET METAL FLASHING AND TRIM for metal flashings installed at perimeters of assemblies.
2. Section 07 92 00 - JOINT SEALANTS for sealants installed at perimeters of metal-framed skylights.
3. Section 08 80 00 - GLAZING for glass units installed in metal-framed skylights.

1.3 PERFORMANCE REQUIREMENTS

A. Provide metal-framed skylights, including anchorage, capable of withstanding, without failure, the effects of the following:

1. Structural loads.
2. Thermal movements.
3. Movements of supporting structure.
4. Dimensional tolerances of building frame and other adjacent construction.

B. Failure includes the following:

1. Deflection exceeding specified limits.
2. Water leakage.
3. Thermal stresses transferred to building structure.
4. Noise or vibration created by wind and thermal and structural movements.
5. Framing members transferring stresses, including those caused by thermal and structural movements, to glazing.
6. Loosening or weakening of fasteners, attachments, and other components.

7. Sealant failure.

C. Structural Loads: Wind loads, snow loads, concentrated live loads and seismic loads as required by Code.

D. Deflection of Framing Members:

1. Deflection Normal to Glazing Plane:

a. Spans Up to 20 Feet: Limited to 1/175 of clear span or 1 inch whichever is smaller.
b. Spans Exceeding 20 Feet: Limited to 1/240 of clear span.
c. Glass Edge Deflection: Limit edge deflection of individual glass lites to 3/4 inch.

2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch whichever is smaller and amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch.

E. Lateral Bracing of Framing Members: Compression flanges of flexural members are laterally braced by cross members with minimum depth equal to 50 percent of flexural member that is braced. Glazing does not provide lateral support.

F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F ambient; 180 deg F material surfaces.

1.4 PERFORMANCE TESTING

A. Provide metal-framed skylights that comply with test-performance requirements indicated, as evidenced by reports of tests performed on manufacturer's standard assemblies.

B. Structural-Performance Test: ASTM E 330.

1. Performance at Design Load: When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
2. Performance at Maximum Test Load: When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main supporting members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity but not less than 10 seconds.

C. Air-Infiltration Test: ASTM E 283.

1. Minimum Static-Air-Pressure Difference: 1.57 lbf/sq. ft.
2. Maximum Air Leakage: 0.06 cfm/sq. ft.

D. Test for Water Penetration under Static Pressure: ASTM E 331.

1. Minimum Static-Air-Pressure Difference: 20 percent of positive wind-load design pressure, but not less than 8 lbf/sq. ft.
2. Water Leakage: None.

E. Test for Water Penetration under Dynamic Pressure: AAMA 501.1.

1. Dynamic Pressure: 20 percent of positive wind-load design pressure, but not less than 12 lbf/sq. ft.
2. Water Leakage: No uncontrolled water penetrating systems or appearing on systems' normally exposed interior surfaces from sources other than condensation. Water controlled by flashing and gutters that is drained to exterior and cannot damage adjacent materials or finishes is not considered water leakage.

1.5 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for metal-framed skylights.

B. LEED Submittals:

1. Credit MR 4: Product data indicating percentage by weight of post-consumer and pre-consumer recycled content for products having recycled content. Include a statement indicating costs for each product having recycled content.
2. Credit IEQ 4.1: Manufacturers' product data for adhesives and sealants, including printed statement of VOC content and MSDS sheets.

C. Shop Drawings: For metal-framed skylights. Include plans, elevations, sections, details, and attachments to other work.

1. Include structural analysis data signed and sealed by the qualified professional engineer, licensed in the jurisdiction where the Project is located, responsible for their preparation.

D. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

E. Fabrication Sample: Of each framing intersection of assemblies, made from 12-inch lengths of full-size components and showing details of the following:

1. Joinery.
2. Anchorage.
3. Expansion provisions.
4. Glazing.
5. Flashing and drainage.

F. Field quality-control test and inspection reports.

G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for metal-framed skylights.

H. Maintenance Data: For metal-framed skylights to include in maintenance manuals.

I. Warranties: Special warranties specified in this Section.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Entity capable of assuming engineering responsibility and performing work of this Section and who is acceptable to manufacturer.

B. Testing Agency Qualifications: An independent agency qualified according to ASTM E 699 for testing indicated.

C. Product Options: Information on Drawings and in Specifications establishes requirements for skylights' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including testing conducted by an independent testing agency and in-service performance.

D. Welding: Qualify procedures and personnel according to AWS D1.2, "Structural Welding Code - Aluminum."

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1.7 PROJECT CONDITIONS

A. Field Measurements: Indicate measurements on Shop Drawings.

1.8 WARRANTY

A. Special Assembly Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal-framed skylights that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including, but not limited to, excessive deflection.
b. Noise or vibration caused by thermal movements.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
d. Adhesive or cohesive sealant failures.
e. Water leakage.

2. Warranty Period: Ten years from date of Substantial Completion.

B. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes fail within specified warranty period. Warranty does not include normal weathering.

1. Failures include, but are not limited to, checking, crazing, peeling, chalking, and fading of finishes.
2. Warranty Period: Ten years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Architectural Skylight Co., Inc.
2. Kawneer North America.
3. LinEl Signature.
4. Oldcastle BuildingEnvelope
5. Skyline Products, Inc.
6. Supersky.
7. Wasco Products, Inc.

2.2 FRAMING SYSTEMS

A. Aluminum: Alloy and temper recommended in writing by manufacturer for type of use and finish indicated.

1. Sheet and Plate: ASTM B 209.
2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
3. Extruded Structural Pipe and Tubes: ASTM B 429.
4. LEED Requirement: Use minimum post-consumer recycled content of 20%.

B. Pressure Caps: Manufacturer's standard aluminum components that mechanically retain glazing. Include snap-on aluminum trim that conceals fasteners.

C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning skylight components.

D. Anchors, Fasteners, and Accessories: Manufacturer's standard, corrosion-resistant, nonstaining, and nonbleeding; compatible with adjacent materials.

1. At pressure caps, use ASTM A 193/A 193M, 300 series stainless-steel screws.
2. Where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
3. Exposed Fasteners:

a. Use exposed fasteners with countersunk Phillips screw heads.
b. Finish exposed portions to match framing system.

4. At movement joints, use slip-joint linings, spacers, and sleeves of material and type recommended in writing by manufacturer.

E. Anchor Bolts: ASTM A 307, Grade A hot-dip zinc coating, ASTM A 153/A 153M, Class C.

F. Concealed Flashing: Manufacturer's standard, corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

G. Exposed Flashing and Closures: Manufacturer's standard aluminum components not less than 0.040 inch thick.

H. Framing Gaskets: Manufacturer's standard

I. Framing Sealants: As recommended in writing by manufacturer.

2.3 GLAZING SYSTEMS

A. Glazing: As specified in Section 08 80 00 - GLAZING.

B. Spacers, Setting Blocks, and Gaskets: Manufacturer's standard elastomeric types.

C. Glazing Sealants: As recommended in writing by manufacturer.

1. Weatherseal Sealant: ASTM C 920 for Type S, Grade NS, Class 25, Uses NT, G, A, and O; neutral-curing silicone formulation compatible with structural sealant and other components with which it comes in contact; and recommended in writing by structural- and weatherseal-sealant and metal-framed skylight manufacturers for this use.

a. Color: Matching structural sealant.

2.4 ACCESSORY MATERIALS

A. Insulating Materials: Specified in Section 07 21 00 - THERMAL INSULATION.

B. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil thickness per coat.

2.5 FABRICATION

A. Fabricate aluminum components before finishing.

B. Fabricate aluminum components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Internal guttering systems or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within skylight to exterior.
4. Physical and thermal isolation of glazing from framing members.
5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.

C. Fabricate aluminum sill closures with weep holes and for installation as continuous component.

D. Reinforce aluminum components as required to receive fastener threads.

E. Weld aluminum components in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

F. Light Tubes: Fabricate as indicated on the Drawings.

2.6 ALUMINUM FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. High-Performance Organic Finish (3-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: conversion coating; Organic Coating: manufacturer's standard 3-coat, thermocured system consisting of specially formulated inhibitive primer, fluoropolymer color coat, and clear fluoropolymer topcoat, with both color coat and clear topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2605 and with coating and resin manufacturers' written instructions.

1. Color and Gloss: As selected by Design Professional from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints between aluminum components to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
6. Seal joints watertight, unless otherwise indicated.

B. Metal Protection: Where aluminum will contact dissimilar materials, protect against galvanic action by painting contact surfaces with bituminous paint or by installing nonconductive spacers as recommended in writing by manufacturer for this purpose.

C. Install continuous aluminum sill closure with weatherproof expansion joints and locked and sealed or welded corners. Locate weep holes at rafters.

D. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within skylight to exterior.

E. Install components plumb and true in alignment with established lines and elevations.

F. Install glazing in accordance with requirements specified in Section 08 80 00 - GLAZING.

G. Install insulation materials as specified in Section 07 21 00 - THERMAL INSULATION.

H. Erection Tolerances: Install metal-framed skylights to comply with the following maximum tolerances:

1. Alignment: Limit offset from true alignment to 1/32 inch where surfaces abut in line, edge to edge, at corners, or where a reveal or protruding element separates aligned surfaces by less than 3 inches; otherwise, limit offset to 1/8 inch.
2. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet but no greater than 1/2 inch over total length.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test and inspection reports.

B. Testing Services: Testing and inspecting of representative areas to determine compliance of installed skylights with specified requirements shall take place as follows and in successive stages as indicated on Drawings. Do not proceed with installation of the next area until test results for previously completed areas show compliance with requirements.

1. ASTM C 1401 recommendations for quality-control procedures.
2. Water Penetration under Static Pressure: Before installation of interior finishes has begun, areas shall be tested according to ASTM E 1105.

   a. Test Procedures: Test under cyclic static air pressure.
   b. Water Penetration: None.

3. Water-Spray Test: Before installation of interior finishes has begun, skylights shall be tested according to AAMA 501.2 and shall not evidence water penetration.

C. Repair or remove work where test results and inspections indicate that it does not comply with specified requirements.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

END OF SECTION 08 63 00

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Finish hardware for doors as specified and as listed in "Hardware Groups" and required by actual conditions.

2. Include screws, special screws, bolts, special bolts, expansion shields, and other devices for proper application of hardware. Installation of hardware with proper factory supplied fasteners is mandatory.

3. Sample door hardware matrix and door numbering criteria

B. Related Sections:

1. Section 01 60 00 - Product Requirements.

2. Section 06 10 00 - Rough Carpentry.

3. Section 06 20 22 - Finish Carpentry.

4. Section 06 41 00 - Architectural Wood Casework.

5. Section 08 11 13 - Hollow Metal Doors and Frames.

6. Section 08 14 16 - Flush Wood Doors.

7. Section 08 31 00 - Access Doors and Panels.

8. Section 08 34 70 – Sound Control Doors and frames

9. Section 08 43 13 - Aluminum-Framed Storefronts.

10. Section 08 71 00 - Door Hardware.

11. Section 08 71 13 – Auto Door Operators

12. Section 08 80 00 - Glazing.

13. Division 26: Electrical

14. Section Section 28 13 00 – Access Control

1.02 GENERAL REQUIREMENTS

A. Provide items, articles, materials, operations and methods listed, mentioned or scheduled herein or on drawings, in quantities as required to complete project. Provide hardware that functions properly. Prior to furnishing hardware, advise Architect of items that will not operate properly, are improper for conditions, or will not remain permanently anchored.

1.03 SUBMITTALS

A. Hardware Schedule: Submit six (6) copies of hardware schedule in vertical format as illustrated by the Sequence of Format for the Hardware Schedule as published by the Door and Hardware Institute. Schedules, which do not comply, will be returned for correction before checking. Hardware schedule shall clearly indicate architect's hardware group and manufacturer of each item proposed. The schedule shall be reviewed prior to submission by a certified Architectural Hardware Consultant (AHC).

1. Provide illustrations from manufacturers catalogs and data in brochure form for all products, including model, function, design, finishes, and options.
2. Check specified hardware for suitability and adaptability to details and surrounding conditions. Indicate unsuitable or incompatible items and proposed substitutions in hardware schedule.
3. Provide listing of manufacturer's template numbers for each item of hardware in hardware schedule.
4. Furnish other Contractors and Subcontractors concerned with copies of final approved hardware schedule. Submit necessary templates and schedules as soon as possible to hollow metal, wood door, and aluminum door fabricators in accordance with schedule they require for fabrication.
5. Samples: Lever design or finish sample: Provide 3 samples if requested by architect.

B. Riser and Wiring Diagrams: Provide complete and detailed system operation and elevation diagrams specially developed for each opening requiring electrified hardware, except openings where only magnetic hold-opens or door position switches are specified. Provide these diagrams with hardware schedule submittal for approval. Provide detailed wiring diagrams with hardware delivery to jobsite.

C. Installation Instructions: Provide manufacturer's written installation and adjustment instructions for finish hardware. Send installation instructions to site with hardware.

D. Templates: Submit templates and final approved hardware schedule to door and frame supplier and others as applicable to enable proper and accurate sizing and locations of cutouts and reinforcing.

E. Closeout Submittals: Comply with Section 01 78 00 including specific requirements indicated.

1. Operating and maintenance manuals: Submit 3 sets containing the following:
   a. Complete information in care, maintenance, and adjustment, and data on repair and replacement parts, and information on preservation of finishes.
   b. Catalog pages for each product.
   c. Name, address, and phone number of local representative for each manufacturer.
   d. Parts list for each product.
2. Copy of final approved hardware schedule, edited to reflect "As installed".
3. Copy of final keying schedule.
4. As installed "Wiring Diagrams" for each opening connected to power, both low voltage and 110 volts.
5. One complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.
6. Copy of all warrantees taken from manufacturer’s catalog pages. Non-cataloged letters of warranty are not acceptable without written authorization from owner. Including all appropriate reference numbers for manufacturers to identify the project.

1.04 QUALITY ASSURANCE

A. Manufacturer: Obtain each type of hardware (i.e. latch and locksets, hinges, closers) from single manufacturer, although several may be indicated as offering products complying with requirements. Locksets and exit device trim shall be have aesthetic design compatibility.

B. All hardware shall be considered stock material by manufacturer and not require machining, special order, or standard factory lead times for replacement, allowing for the prompt repair and maintenance of hardware as required. Only manufacturer's fasteners can be used on locksets, fire rated exit devices, and door closers. No altering of cylindrical keyways.

C. Where doors are scheduled to be prepared for the future application of electronic hardware, furnish mechanical hardware that will require no additional door preparation when future conversion to electrical function takes place.

D. Where free-wheeling lockset or exit device trim is specified, "shear pin" or "break away" style trims shall not be used.

E. Supplier: Recognized architectural finish hardware supplier, with warehousing facilities, who has been providing hardware for period of not less than 3 years. The supplier shall be, or employ, a certified Architectural Hardware Consultant (AHC), who is registered in the continuing education program as administered by the Door and Hardware Institute. The hardware schedule shall be prepared and signed by a certified AHC.

F. Installer: Firm with 3 years experience in installation of similar hardware to that required for this project, including specific requirements indicated. Installation must be of high quality. Such practices as grinding strike plates will not be tolerated.

G. Regulatory Label Requirements: Provide nationally recognized testing agency label or stamp on hardware for labeled openings. Where UL requirements conflict with drawings or specifications, hardware conforming to UL requirements shall be provided. Conflicts and proposed substitutions shall be clearly indicated in hardware schedule.

H. Handicap Requirements: Doors to stairs (other than exit stairs), loading platforms, boiler rooms, stages and doors serving other hazardous locations shall have knurled or other similar approved marking of door lever handles or cross bars in accordance with local building codes.

I. Pre-Installation Conference: Prior to the installation of hardware, manufacturer's representatives for locksets, closers, and exit devices shall arrange and hold a jobsite meeting to instruct the installing contractor's personnel on the proper installation of their respective products. A letter of compliance, indicating when this meeting is held and who is in attendance, shall be sent to the Architect and Owner.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver hardware to jobsite in manufacturer's original packaging, marked to correspond with approved hardware schedule. Do not deliver hardware until suitable locked storage space is available. Check hardware against reviewed hardware schedule. Store hardware to protect against loss, theft or damage.

B. Deliver hardware required to be installed during fabrication of hollow metal, aluminum, wood, or stainless steel doors prepaid to manufacturer.

1.06 WARRANTY

A. Guarantee workmanship and material provided against defective manufacture. Repair or replace defective workmanship and material appearing within period of one year after Substantial Completion.

B. Provide ten year factory warranty on door closer body against defects in material and workmanship from date of occupancy of project.

C. Provide five year factory warranty on exit devices against defects in material and workmanship from date of occupancy of project. Provide two year factory warranty on electrified exit devices

against defects in material and workmanship from date of occupancy of project.

D. Cylindrical grade one through-bolted locksets supplied as equivalent to Sargent 10 Line shall have a five year factory warranty. Mortise locksets shall have a five year factory warranty from date of occupancy. All warranties shall be against defects in material or workmanship from date of occupancy of project.

E. All power supplies and electronic hardware shall be by the same manufacturer to insure compatibility, proper function and warranty compliance. Field manufactured power supplies are not acceptable.

F. All products furnished equivalent to HES electric strike model 1003 and 9600 shall have a 10 year warranty against defects in material or workmanship, compliant with "E" above.

G. All products furnished as equivalent to Securitron products shall have a warranty similar to Securitron's MAGNACARE Lifetime Replacement Warranty. Securitron Magnalock Corporation warrants that it will replace at customer's request, at any time for any reason, products manufactured and branded by Securitron. Refer to Securitron's warranty to insure compliance.

H. Replace shortages and incorrect items with correct material at no additional cost to Owner.

I. At completion of project, a qualified factory representative shall inspect hardware installation and door closer adjustments. After this inspection, letter shall be sent to Architect reporting on conditions, verifying that hardware and closers have been properly installed and adjusted.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers listed have been chosen to establish a standard of quality, design, and function.

B. Manufacturers have been approved only for the category or item listed. **The first manufacturer listed is the preferred manufacturer for each product**, and the submittal of any of manufacturer, even the 1st and 2nd equal, or a manufacturer not listed for any product, is not necessarily acceptable for use and must follow the submittal procedures as outlined in Specification Section 01631 – Equals and Substitutions.

C. Product descriptions in subsequent Sections 2.2 to 2.35 take 1st precedent over listing order of manufacturers in 2.1, but only those manufacturers listed may be used. Actual hardware groups in Section 4.2 take next precedent over listing order of the manufacturers in 2.1

D. Manufacturer information:

1. The following is an alphabetical list of approved manufacturers, address, and website (if available). This information is being supplied for reference only and in no way implies product acceptance. Only the products listed in the respective category are considered to be acceptable for this project.

1)	ABH	Elk Grove, IL	www.abhmfg.com
2)	Dor-o-matic	Harwood Heights, IL	www.doromatic.com
3)	Folger Adam	Lemont, IL	www.folgeradamsecurity.com
4)	Glynn-Johnson	Indianapolis, IN	www.glynnjohnson.com
5)	Hager	St. Louis, MI	www.hagerhinge.com
6)	HES	Phoenix, AZ	www.hesinnovations.com
7)	Key Control	Katy, TX	www.key-control-inc.com
8)	LCN	Princeton, IL	www.lcnclosers.com
9)	Lund	Bath, OH	www.lundkeycab.com
10)	McKinney	Scranton, PA	www.mckinneyhinge.com
11)	National Guard	Memphis, TN	www.ngpinc.com
12)	Norton	Monroe, NC	www.yalesecurity.com

13)	Pemko	Memphis, TN	www.pemko.com
14)	Precision	Romulus, MI	www.precisionhardware.com
15)	Quality	Los Angeles, CA	www.trimcobbw.com
16)	Reese	Rosemont, MN	www.reeseusa.com
17)	Rixson	Monroe, NC	www.yalesecurity.com
18)	Rockwood	Rockwood, PA	www.rockwoodmfg.com
19)	Roton	St. Louis, MI	www.hagerhinge.com
20)	Sargent	New Haven, CT	www.sargentlock.com
21)	Schlage	Colorado Springs, CO	www.schlage.com
22)	Securitron	Sparks, NV	www.securitron.com
23)	Sentrol	Tualatin, OR	www.sentrol.com
24)	Stanley	New Britain, CT	www.stanleyworks.com
25)	Telkee	Dover, DE	www.telkee.com
26)	Von Duprin	Indianapolis, IN	www.vonduprin.com
27)	Locknetics		

2.02 BUTTS AND HINGES

A. Acceptable Manufacturers and Products:

Manufacturer	Equal Mfg. 1	Equal Mfg. 2
McKinney	Hager	Stanley
TA2714	BB1279	FBB179
T4A3786	BB1168	FBB168

B. Drill 5/32 inch hole and use No. 12, 1-1/4 inch steel threaded to the head wood screws for hinges on wood doors.

2.03 ELECTRIC HINGES

A. Acceptable Manufacturers and Products:

Manufacturer	Equal Mfg. 1	Equal Mfg. 2
McKinney	Hager	Stanley
QC	QC Equal	QC Equal

B. Transfer hinges shall be provided with molex standardized plug connectors to accommodate up to twelve (12) wires. Plug connectors shall plug directly into molex through-door wiring harness for connection to electric locking devices and power supplies. Provide sufficient number of concealed wires to accommodate electric function of specified hardware. Provide a mortar guard for each transfer hinge specified.

C. Electric hinges to be located at second hinge from bottom. Where electric hinges are used in conjunction with exit devices, locate hinge nearest to exit device.

D. Provide mortar guard similar to McKinney MG-16 for each electric hinge specified.

2.04 CONTINUOUS HINGES

A. Acceptable Manufacturers and Products:

Manufacturer	Equal Mfg. 1	Equal Mfg. 2
Pemko	Roton	Stanley
CFM SLF HD1	780-112HD	501
CFM HD1	780-224HD	521

B. Provide one of the above two models of continuous hinges as appropriate for the type, inset, and thickness of door where specified. Coordinate hinge types with the door supplier.

C. Provide eight (8) adjusta-screws per hinge to assist in alignment of door in frame.

2.05 TRANSFER CONTINUOUS HINGES

A. Acceptable Manufacturers and Products:

Manufacturer	Equal Mfg. 1
McKinney	Pemko
SER	SER

B. Electric continuous hinges shall be provided with molex standardized plug connectors to accommodate up to twelve (12) wires. Plug connectors shall plug directly into molex through-door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number of concealed wires to accommodate electric function of specified hardware.

C. Provide 96” lead with standardized molex connector on one end for attaching to the frame leaf with exposed wire end for attaching to power supply. Also provide 48” lead with standardized molex connectors on both end for attaching to the door leaf and the electrified hardware item.

2.06 POWER SUPPLIES

A. Acceptable Manufacturers and Products:

Manufacturer	Equal Mfg. 1	Equal Mfg. 2
Sargent	Securitron	Von Duprin
3500 Series	BPS Series	PS Series

B. Provide a power supply, necessary for the operation of the electronic component, for each electric lock, electric exit devices, electromagnetic locks, electric strike, and other components requiring a power supply.

C. The power supply shall furnish regulated and filtered 24 VDC (or as required) and shall be UL class 2 listed. Provide 1, 4, or 8 separate output circuit breakers to divide load. LED’s shall monitor zone status (voltage no voltage) and slide switches shall be provided to connect or disconnect the load from power. The power supply shall have the internal capability of charging optional sealed lead acid backup batteries (24 VDC or as required) in addition to operating the DC load. The power supply shall be supplied complete requiring only 120VAC to the fused input and shall be supplied in an enclosure. The power supply shall be supplied with emergency release terminals that allow the release of all devices upon activation of the fire alarm system.

2.07 FLUSH BOLTS AND DUSTPROOF STRIKES

A. Acceptable Manufacturers and Products:

Manufacturer	Equal Mfg. 1
Rockwood	Hager
555	282D
555	282D
570	570

B. Non-labeled Openings: Provide 2 flush bolts 555 for inactive leaf of pairs of locked and latched doors. Locate centerline of top bolt not more than 78 inches from finished floor. Provide dustproof strike 570 for bottom bolt.

2.04 MORTISE LOCKS

A. Acceptable Manufacturers and Products:

Manufacturer	Equal Mfg. 1	Equal Mfg. 2
Sargent	Schlage	Best
8200	L9000	45H

B. Provide lock series and functions as specified in Hardware Groups, with the provisions below. Sargent product numbers are referenced in the Hardware Groups.

1. Cylinders: Refer to keying requirements
2. Backsets: 2-3/4 inches.
3. Strikes: Provide wrought boxes and curved lip strikes with proper lip length to protect trim but not to project more than 1/8 inch beyond trim, frame or inactive leaf. Where required, provide open back strike and protected to allow practical and secure operation.
4. Doors to stairs (other than exit stairs), loading platforms, boiler rooms, stages and doors serving other hazardous locations shall have knurled or other similar approved marking of door lever handles or cross bars in accordance with local building codes.

2.09 PANIC HARDWARE

A. Acceptable Manufacturers and Products:

Manufacturer	Equal Mfg. 1	Equal Mfg. 2
Sargent	Von Duprin	Precision
80 Series	98/35 Series	Apex Series

B. Provide panic hardware series and functions as specified in Hardware Groups. Sargent product numbers are referenced in the Hardware Groups.

C. All panic hardware shall be UL listed for panic. Panic hardware for labeled doors shall be UL listed as "Fire Exit Hardware".

D. Where lever trim is specified, provide lever design to match lockset levers.

E. Provide cylinders for panic hardware with locking trim.

F. All non-fire rated exit devices shall have keyed cylinder mechanical dogging, including where “Electric Latch Retraction or Pull Back” and “Request to Exit” options are specified.

G. Provide keyed cylinder removable mullions as specified in the Hardware Groups.

2.10 KEYING

A. Provide Sargent factory masterkeyed cylinders keyed to existing Sargent Restricted Masterkey System. Key system is on file at Sargent factory. NO SUBSTITUTIONS will be allowed.

B. Provide manufacturers standard cylinders (non removable core type – removable core cylinders will not be accepted and will be replaced at supplier’s cost if furnished).

C. Factory key all cylinders with manufacturer retaining permanent keying records.

D. Submit proposed keying schedule to Architect. Meet with Owner and Architect to review schedule.

E. All cylinders, unless noted otherwise, shall be operated by one of a series of Existing Grand Master Keys

OR

F. All cylinders, unless noted otherwise, shall be operated by one of a series of New Master Keys, under the existing system, as noted by their respective key set number herein, to be established for this project. Allow for twenty (20) Master Keys under each of the above Grand Master Keys. (Do not use the letter "I" or “O” in any of the master key sets.)

G. All cylinders shall be keyed in alike or different sets as noted by their respective key set number. Allow for fifty (50) change keys under each of the above master keys.

H. All keys are to be cut on Restricted key blanks in accordance with existing Sargent Restricted Masterkey System. Provide keys as follows:

1. Do not issue Grand Master Keys
2. Ten (10) Master Keys (each set)
3. Five (5) Change Keys (each cylinder)
4. Five (5) Construction Master Keys

I. Visual key control:

1. All keys shall be stamped with their respective key set number and stamped “DO NOT DUPLICATE".
2. Master keys shall be stamped with their respective key set letters.
3. Do not stamp any cylinders with key set on face (front) of cylinder.

J. All keyblanks, master and grandmaster keys shall be shipped directly from the factory to the University via registered mail, confidential, or, per the University’s instructions, delivered directly to the University by the hardware supplier who shall obtain a receipt for delivery of same. All change keys shall ship with locksets or exit devices for the purpose of installation. Upon completion of installation, change keys shall be tagged, registered, and placed accordingly within key control cabinet for final delivery to the University. Meet with University prior to the initiation of hardware installation to coordinate how change keys are to be tagged, registered, and placed within key cabinet.

There is to be NO construction keying for all buildings. The locks will be keyed at the factory according to a keying system layout that is to be determined at the keying meeting. The GC will be given an agreed number of master keys that the GC will use to lock & unlock doors in the building during construction.

At the end of construction, ALL master keys that were given to the GC must be returned and accounted for. If any of the master keys are lost by the GC, the GC will be responsible for re-keying the entire building.

2.11 DOOR TRIM

A. Acceptable Manufacturers and Products:

Manufacturer	Equal Mfg. 1
Rockwood	Hager

2.12 DOOR CLOSERS

A. Acceptable Manufacturers and Products:

Manufacturer	Equal Mfg. 1
Sargent	LCN

281-CPS	4111S-CUSH
281-CPSH	4111H-CUSH
281-O	4011
281-P10	4111EDA

B. Provide all closers on exterior openings with a stop arm, unless noted otherwise.

C. No P-9 arms shall be allowed on exterior parallel arm closers

D. Provide all closers on interior openings with a parallel arm, unless noted otherwise.

E. Provide non-sized closers, adjustable to meet maximum opening force requirements of ADA.

F. Provide drop plates, brackets, or adapters for arms as required to suit details.

G. Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors. Closers shall not be visible in corridors, lobbies and other public spaces unless necessary.

H. Provide back-check for closers.

I. Provide hold-open arms where indicated.

J. Provide delayed action where indicated.

K. Provide closers for doors as noted in Hardware Groups and, in addition, provide closers for labeled doors whether or not specifically noted in group.

L. Provide closers meeting the requirements of UBC 7-2 and UL 10C positive pressure tests.

M. Provide sex bolt attachments or blocking for mineral core door application as directed by Architect and/or door specifications.

2.13 OVERHEAD STOPS

A. Acceptable Manufacturers and Products:

Manufacturer	Equal Mfg. 1	Equal Mfg. 2
Sargent	ABH	Rixson
1530	3300	5
1540	3300	10

B. Provide 1540 Series overhead stops for doors equipped with regular arm surface type closer that swing more than 140 degrees before striking wall, and for doors that open against equipment, casework, sidelights, other objects that would make wall stops inappropriate.

C. Provide sex bolt attachments or blocking for mineral core door application as directed by Architect and/or door specifications.

2.14 STOPS AND HOLDERS

A. Acceptable Manufacturers and Products:

Manufacturer	Equal Mfg. 1
Rockwood	Hager
406	232W
409	236W
445	FS05

B. Provide Rockwood #406 wall stop at mortise locksets and #409 wall stop at cylindrical locksets for each door leaf except where floor stops are scheduled in Hardware Groups. Where conditions do not allow a wall stop or a floor stop presents a tripping hazard, then provide an overhead stop.

C. Provide 1540 Series overhead stops for doors that swing more than 140 degrees before striking a wall.

D. Floor or base stops shall be used only where definitely specified or absolutely unavoidable.

2.15 THRESHOLDS

A. Acceptable Manufacturers and Products:

Manufacturer	Equal Mfg. 1	Equal Mfg. 2
Pemko	Reese	National Guard

B. Provide all thresholds as specified.

1. Refer to drawings for special details. Provide accessories, shims and fasteners.

2. Where thresholds occur at openings with one or more mullions, they shall be cut for the mullions and extended continuously for the entire opening.

2.16 WEATHERSTRIPPING

A. Acceptable Manufacturers and Products:

Manufacturer	Equal Mfg. 1	Equal Mfg. 2
Pemko	Reese	National Guard

B. Where weather stripping is specified in hardware groups, provide 316AV at jambs, unless detailed or scheduled otherwise.

1. Provide self-tapping fasteners for weather stripping being applied to hollow metal frames.

C. Where astragals are specified in hardware groups, provide 2 pieces of 18061CP unless detailed or scheduled otherwise.

D. Where sweeps are specified in hardware groups, provide 315CN unless detailed or scheduled otherwise.

E. Where rain drips are specified in hardware groups, provide 346C x full frame width, unless detailed otherwise.

2.17 GASKETING

A. Acceptable Manufacturers and Products:

Manufacturer	Equal Mfg. 1	Equal Mfg. 2
Pemko	Reese	National Guard

B. Provide accessories, shims and fasteners.

C. Provide gaskets for 20-minute doors and doors designated for smoke and draft control.

D. Where frame applied intumescent seals are required by the manufacturer, provide gaskets that comply with UBC 7-2 and UL 10C positive pressure tests.

2.18 SOUND GASKETING

A. Acceptable Manufacturers and Products:

Manufacturer	Equal Mfg. 1	Equal Mfg. 2
Pemko	Reese	National Guard

2.19 SILENCERS

A. Acceptable Manufacturers and Products:

Manufacturer	Equal Mfg. 1
Rockwood	Hager
608	307D

B. Where weatherstripping or gasketing is not used provide the appropriate silencer for each frame.

2.20 KEY CABINET

A. Provide key cabinets by Lund Equipment, Telkee Incorporated, or Key Control.

B. Lund Deluxe wall type cabinet, Series 1200.

C. Provide cabinet with one hook for each lock or cylinder plus at least 50 percent extra hooks.

D. Provide each hook with one non-removable security key tag and one snap-on link duplicate key tag.

E. Provide tools, instruction sheets and accessories required to complete installation.

F. Contractor shall set up the key cabinet in the Facilities Operations Locksmith Shop at 615 Fitch Street, Hamden, CT. Set up shall include placing labeled keys on hooks in numerical sequence and providing a complete set on index cards.

2.21 KEY MANAGEMENT SOFTWARE

A. Provide Sargent Key Wizard® key management software.

B. Software shall provide tracking, issuing, collecting and transferring information regarding keys.

C. Provide training for Owner's personnel on the proper operation and application of the key management software.

2.22 FASTENERS

A. Including, but not limited to, wood or machine screws, bolts, bolts, nuts, anchors, etc. of proper type, material, and finish required for installation of hardware.

B. Use phillips head for exposed screws. Do not use aluminum screws to attach hardware.

C. Provide self-tapping (TEC) screws for attachment of sweeps and stop-applied weatherstripping.

D. Install all hardware with only fasteners provided by the Manufacturer for use with the specific product and according to the Manufacturers written instructions.

2.23 TYPICAL FINISHES AND MATERIALS

A. Finishes, unless otherwise specified:

1. Butts: Exterior Doors

a. 32D (BHMA 630) on Stainless Steel

2. Butts: Interior Doors
   a. 26D (BHMA 652) on Steel
3. Continuous Hinges:
   a. US28 (BHMA 628) on Aluminum
4. Flush Bolts:
   a. 26D (BHMA 626) on Brass or Bronze
5. Exit Devices:
   a. 32D (BHMA 630) on Stainless Steel
6. Locks and Latches:
   a. 32D (BHMA 630) on Stainless Steel
7. Push Plates, Pulls and Push Bars:
   a. 32D (BHMA 630) on Stainless Steel
8. Kick Plates, Armor Plates, and Edge Guards:
   a. 32D (BHMA 630) on Stainless Steel
9. Overhead Stops and Holders:
   a. 26D (BHMA 626) on Brass or Bronze
10. Closers: Surface mounted.
    a. Sprayed Aluminum Lacquer.
11. Miscellaneous Hardware:
    a. 26D (BHMA 626) on Brass or Bronze

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine doors, frames, and related items for conditions that would prevent the proper application of finish hardware. Do not proceed until defects are corrected.

3.02 INSTALLATION

A. Install finish hardware in accordance with reviewed hardware schedule and manufacturer's printed instructions. Prefit hardware before finish is applied, remove and reinstall after finish is completed. Install hardware so that parts operate smoothly, close tightly and do not rattle.

B. Installation of hardware shall comply with NFPA 80 and NFPA 101 requirements.

C. Set units level, plumb and true to line and location. Adjust and reinforce attachment to substrate as necessary for proper installation and operation.

D. Drill and countersink units that are not factory-prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.

E. Set thresholds for exterior doors in full bed of butyl-rubber or polyisobutylene mastic sealant,

forming tight seal between threshold and surface to which set. Securely and permanently anchor thresholds, using countersunk non-ferrous screws to match color of thresholds (stainless steel screws at aluminum thresholds).

F. Electronic hardware shall be furnished and installed by qualified tradespersons. All wiring shall be installed and tested by contractor and hardware installer. Door hardware installer shall be present to complete final adjustments to door hardware. After installation and testing has been completed, the University's security company (AST) shall tap into the system with a relay and connections to the campus wide security system.

3.03 FIELD QUALITY CONTROL

A. After installation has been completed, a qualified person from the hardware supplier is to check the Project to determine proper application of finish hardware according to schedule. Also check operation and adjustment of all hardware items.

B. Installer shall deliver to owner, upon completion, one set of installation and maintenance instructions and specialty tools for all hardware items.

C. Upon owner's request, hardware consultant shall inspect application, installation and adjustment of hardware for proper installation.

3.04 ADJUSTING AND CLEANING

A. At completion, hardware shall be left clean and free from disfigurement. Make adjustment to door closers and other items of hardware. Where hardware is found defective repair or replace or otherwise correct as directed.

B. Adjust door closers to meet opening force requirements of Uniform Federal Accessibility Standards.

C. Adjust door control devices to compensate for final operation of heating and ventilating equipment.

D. Adjustment: Wherever hardware installation is made more than one month prior to acceptance or occupancy of space or area, return to work during week prior to acceptance or occupancy, and make/ check adjustments of hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors.

E. Final Adjustment: Installer shall return six months after substantial completion to make final adjustments of all hardware items.

F. Installer shall instruct Owner's personnel in proper adjustment and maintenance of door hardware and hardware finishes.

G. Clean adjacent surfaces soiled by hardware installation.

3.05 PROTECTION

A. Provide for proper protection of items of hardware until Owner accepts Project as complete.

3.06 HARDWARE GROUPS AND SUFFIXES

A. The following schedule of hardware groups shall be considered a guide only, and the supplier is cautioned to refer to general conditions, special conditions, and the preamble to this section. It shall be the hardware supplier's responsibility to furnish all required hardware.

B. Refer to the door schedule for special hardware notes, applications, and/or requirements.

3.07 MANUFACTURERS ABBREVIATIONS

1. MK - McKinney
2. RO - Rockwood
3. SA - Sargent
4. NO - Norton
5. RF - Rixson
6. PE - Pemko
7. SU - Securitron

3.08 HARDWARE SETS

Set: 1.0

1	Transfer Continuous Hinge	CFM SLF HD1 SER-12	CL	MK
1	Rim Exit (nightlatch)	16 8804 FSL	US32D	SA
1	Drop Plate	281D	EN	SA
1	Surface Closer	281 CPS	EN	SA
1	Perimeter Gasket	Section 08 41 13		
1	Threshold	2005AT MSES10SS		PE
1	Concealed Door Contact	Section 28 13 00		

Set: 2.0

1	Transfer Continuous Hinge	CFM SLF HD1 SER-12	CL	MK
1	ELR Rim Exit (fail secure)	16 56 8810 FLL	US32D	SA
1	Automatic Operator	Section 08 71 13		
1	Perimeter Gasket	Section 08 41 13		
1	Threshold	2005AT MSES10SS		PE
1	Frame Wiring Harness	QC-C1500P		MK
1	Door Wiring Harness	QC-C012		MK
1	Concealed Door Contact	Section 28 13 00		

Set: 3.0

1	Continuous Hinge	CFM SLF HD1	CL	MK
1	Rim Exit (dummy)	16 8810 FLL	US32D	SA
1	Drop Plate	281D	EN	SA
1	Surface Closer	281 CPS	EN	SA
1	Perimeter Gasket	Section 08 41 13		
1	Threshold	2005AT MSES10SS		PE
1	Concealed Door Contact	Section 28 13 00		

Set: 4.0

1	Transfer Continuous Hinge	CFM SLF HD1 SER-12	CL	MK
1	ELR Rim Exit (fail secure)	16 56 8804 FSL	US32D	SA
1	Automatic Operator	Section 08 71 13		
2	Operator Wall Switch	660		NO
1	Perimeter Gasket	Section 08 41 13		
1	Threshold	2005AT MSES10SS		PE
1	Power Supply	BPS-24-2		SU
1	Access Control	Section 28 13 00		
1	Concealed Door Contact	Section 28 13 00		

Set: 5.0

1	Continuous Hinge	CFM SLF HD1	CL	MK
1	Transfer Continuous Hinge	CFM SLF HD1 SER-12	CL	MK
1	Removable Mullion	L980A	US28	SA
1	Mullion Cylinder Kit	980C1		SA
1	Rim Exit (dummy)	16 8810 FLL	US32D	SA
1	ELR Rim Exit (fail secure)	16 56 8804 FSL	US32D	SA
1	Drop Plate	281D	EN	SA
1	Surface Closer	281 CPS	EN	SA
1	Automatic Operator	Section 08 71 13		
1	Astragal	Section 08 41 13		
1	Perimeter Gasket	Section 08 41 13		
1	Threshold	2005AT MSES10SS		PE
1	Power Supply	BPS-24-2		SU
1	Access Control	Section 28 13 00		
2	Concealed Door Contact	Section 28 13 00		

Set: 6.0

1	Transfer Continuous Hinge	CFM SLF HD1 SER-12	CL	MK
1	ELR Rim Exit (fail secure)	16 56 8804 FSL	US32D	SA
1	Automatic Operator	Section 08 71 13		
1	Frame Wiring Harness	QC-C1500P		MK
1	Door Wiring Harness	QC-C012		MK
1	Power Supply	BPS-24-2		SU
1	Access Control	Section 28 13 00		

Set: 7.0

1	Transfer Continuous Hinge	CFM SLF HD1 SER-12	CL	MK
1	ELR Rim Exit (fail secure)	16 56 8810 FLL	US32D	SA
1	Automatic Operator	Section 08 71 13		
1	Frame Wiring Harness	QC-C1500P		MK
1	Door Wiring Harness	QC-C012		MK
1	Power Supply	BPS-24-2		SU

Set: 8.0

1	Continuous Hinge	CFM SLF HD1	CL	MK
1	Mortise Lock (storeroom)	76 8204 LNL	US32D	SA
1	Drop Plate	281D	EN	SA
1	Surface Closer	281 CPS	EN	SA
1	Perimeter Gasket	Section 08 41 13		
1	Threshold	2005AT MSES10SS		PE
1	Concealed Door Contact	Section 28 13 00		

Set: 9.0

1	Continuous Hinge	CFM HD1	CL	MK
1	Transfer Continuous Hinge	CFM HD1 SER-12	CL	MK
1	Flush Bolt	555 36"	US26D	RO
1	Flush Bolt	555	US26D	RO
1	Dust Proof Strike	570	US26D	RO

1	Electrified Mortise Lock (fail secure)	8271 7/8" Lip Length LNL	US32D	SA
2	Surface Closer (stop)	281 CPS	EN	SA
2	Armor Plate	K1050 34" 4BE CSK	US32D	RO
1	Astragal	357SP		PE
1	Perimeter Gasket	S88		PE
1	Threshold	2005AT MSES10SS		PE
1	Frame Wiring Harness	QC-C1500P		MK
1	Door Wiring Harness	QC-C300		MK
1	Power Supply	BPS-24-2		SU
1	Access Control	Section 28 13 00		
2	Concealed Door Contact	Section 28 13 00		

Set: 10.0

1	Continuous Hinge	CFM HD1	CL	MK
1	Mortise Lock (storeroom)	76 8204 LNL	US32D	SA
1	Surface Closer (stop)	281 CPS	EN	SA
1	Kick Plate	K1050 8" 4BE CSK	US32D	RO
1	Perimeter Gasket	S88		PE
1	Threshold	2005AT MSES10SS		PE
1	Concealed Door Contact	Section 28 13 00		

Cylinder to be on inside face of door.

Set: 11.0

2	Continuous Hinge	CFM HD1	CL	MK
2	Flush Bolt	555	US26D	RO
1	Dust Proof Strike	570	US26D	RO
1	Mortise Lock (storeroom)	76 8204 7/8" Lip Length LNL	US32D	SA
1	Surface Closer (stop)	281 CPS	EN	SA
2	Kick Plate	K1050 8" 4BE CSK	US32D	RO
1	Astragal	357SP		PE
1	Perimeter Gasket	S88		PE
1	Threshold	2005AT MSES10SS		PE
1	Concealed Door Contact	Section 28 13 00		

Set: 12.0

2	Hinge	TA2714 NRP 4-1/2" x 4-1/2"	US26D	MK
1	Transfer Hinge	TA2714 QC12 4-1/2" x 4-1/2"	US26D	MK
1	Electrified Mortise Lock (fail secure)	76 8271 LNL	US32D	SA
1	Surface Closer (stop)	281 CPS	EN	SA
1	Kick Plate	K1050 8" 4BE CSK	US32D	RO
1	Frame Wiring Harness	QC-C1500P		MK
1	Door Wiring Harness	QC-C300		MK
1	Power Supply	BPS-24-2		SU
1	Access Control	Section 28 13 00		
1	Concealed Door Contact	Section 28 13 00		

Set: 13.0

2	Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK
1	Transfer Hinge	TA2714 QC12 4-1/2" x 4-1/2"	US26D	MK
1	Electrified Mortise Lock (fail secure)	76 8271 LNL	US32D	SA

1	Surface Closer	281 O	EN	SA
1	Kick Plate	K1050 8" 4BE CSK	US32D	RO
1	Wall/Floor Stop	401/445 As Required	US26D	RO
3	Silencer	608		RO
1	Frame Wiring Harness	QC-C1500P		MK
1	Door Wiring Harness	QC-C300		MK
1	Power Supply	BPS-24-2		SU
1	Access Control	Section 28 13 00		

Set: 14.0

3	Hinge (heavy weight)	T4A3786 4-1/2" x 4-1/2"	US26D	MK
1	Mortise Lock (entry)	8256 LNL	US32D	SA
1	Concealed Overhead Stop	1530S Series	US26D	SA
1	Surface Closer	281 O	EN	SA
1	Kick Plate	K1050 8" 4BE CSK	US32D	RO
1	Wall/Floor Stop	401/445 As Required	US26D	RO
3	Silencer	608		RO

Set: 15.0

2	Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK
1	Transfer Hinge	TA2714 QC12 4-1/2" x 4-1/2"	US26D	MK
1	Electrified Mortise Lock (fail secure)	76 8271 LNL	US32D	SA
1	Surface Closer	281 O	EN	SA
1	Kick Plate	K1050 8" 4BE CSK	US32D	RO
1	Wall/Floor Stop	401/445 As Required	US26D	RO
1	Perimeter Sound Gasket	S773		PE
1	Mortise Auto Door Bottom	434ARL/420ASL As Required		PE
1	Threshold	173A MSES10SS		PE
1	Frame Wiring Harness	QC-C1500P		MK
1	Door Wiring Harness	QC-C300		MK
1	Power Supply	BPS-24-2		SU
1	Access Control	Section 28 13 00		

Set: 16.0

5	Hinge (heavy weight)	T4A3786 NRP 4-1/2" x 4-1/2"	US26D	MK
1	Transfer Hinge (heavy weight)	T4A3786 QC-12 4-1/2" x 4-1/2"	US26D	MK
2	Flush Bolt	555	US26D	RO
1	Dust Proof Strike	570	US26D	RO
1	Electrified Mortise Lock (fail secure)	8271 7/8" Lip Length LNL	US32D	SA
2	Surface Closer (stop)	281 CPS	EN	SA
2	Kick Plate	K1050 8" 4BE CSK	US32D	RO
1	Astragal	357SP		PE
3	Silencer	608		RO
1	Frame Wiring Harness	QC-C1500P		MK
1	Door Wiring Harness	QC-C400		MK
1	Power Supply	BPS-24-2		SU
1	Access Control	Section 28 13 00		

Set: 17.0

3	Hinge (heavy weight)	T4A3786 4-1/2" x 4-1/2"	US26D	MK
1	Rim Exit (classroom)	16 8813 ETL	US32D	SA

1 Surface Closer (stop)	281 CPS	EN	SA
1 Kick Plate	K1050 8" 4BE CSK	US32D	RO
3 Silencer	608		RO

Set: 18.0

6 Hinge (heavy weight)	T4A3786 4-1/2" x 4-1/2"	US26D	MK
2 Push Pull	111x73C/73CL	US32D	RO
2 EM Wall Holder	998	689	RF
2 Surface Closer	281 P10	EN	SA
2 Kick Plate	K1050 8" 4BE CSK	US32D	RO
2 Silencer	608		RO

Set: 19.0

6 Hinge (heavy weight)	T4A3786 4-1/2" x 4-1/2"	US26D	MK
2 Push Plate	70C	US32D	RO
2 EM Wall Holder	998	689	RF
2 Surface Closer	281 P10	EN	SA
4 Kick Plate	K1050 8" 4BE CSK	US32D	RO
2 Silencer	608		RO

Set: 20.0

6 Hinge (heavy weight)	T4A3786 4-1/2" x 4-1/2"	US26D	MK
2 Push Plate	70C	US32D	RO
2 Surface Closer	281 P10	EN	SA
2 Kick Plate	K1050 8" 4BE CSK	US32D	RO
2 Wall/Floor Stop	401/445 As Required	US26D	RO
2 Silencer	608		RO

Set: 21.0

4 Hinge (heavy weight)	T4A3786 4-1/2" x 4-1/2"	US26D	MK
2 Transfer Hinge (heavy weight)	T4A3786 QC-12 4-1/2" x 4-1/2"	US26D	MK
2 SVR Exit (passage)	12 56 NB8715 ETL	US32D	SA
1 Surface Closer (stop)	281 CPS	EN	SA
1 Automatic Operator	Section 08 71 13		
2 Kick Plate	K1050 8" 4BE CSK	US32D	RO
2 Silencer	608		RO
2 Frame Wiring Harness	QC-C1500P		MK
2 Door Wiring Harness	QC-C012		MK
1 Power Supply	BPS-24-2		SU

Set: 22.0

6 Hinge (heavy weight)	T4A3786 4-1/2" x 4-1/2"	US26D	MK
2 Multipoint Lock (passage)	12 NB7015 ETL	US26D	SA
2 Surface Closer (stop)	281 CPS	EN	SA
2 Kick Plate	K1050 8" 4BE CSK	US32D	RO
2 Silencer	608		RO
2 Concealed Door Contact	Section 28 13 00		

Set: 23.0

3	Hinge (heavy weight)	T4A3786 4-1/2" x 4-1/2"	US26D	MK
1	Rim Exit (passage)	12 8815 ETL	US32D	SA
1	Surface Closer	281 O	EN	SA
1	Kick Plate	K1050 8" 4BE CSK	US32D	RO
1	Wall/Floor Stop	401/445 As Required	US26D	RO
3	Silencer	608		RO

Set: 24.0

3	Hinge (heavy weight)	T4A3786 4-1/2" x 4-1/2"	US26D	MK
1	Rim Exit (passage)	12 8815 ETL	US32D	SA
1	Surface Closer (stop)	281 CPS	EN	SA
1	Armor Plate	K1050 34" 4BE CSK	US32D	RO
3	Silencer	608		RO

Set: 25.0

3	Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK
1	Rim Exit (storeroom)	LD 76 8804 ETL	US32D	SA
1	Surface Closer (stop)	281 CPS	EN	SA
1	Kick Plate	K1050 8" 4BE CSK	US32D	RO
3	Silencer	608		RO

Set: 26.0

3	Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK
1	Rim Exit (storeroom)	12 76 8804 ETL	US32D	SA
1	Surface Closer	281 CPS	EN	SA
1	Kick Plate	K1050 8" 4BE CSK	US32D	RO
3	Silencer	608		RO

Set: 27.0

3	Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK
1	Mortise Lock (storeroom)	76 8204 LNL	US32D	SA
1	Surface Closer	281 O	EN	SA
1	Kick Plate	K1050 8" 4BE CSK	US32D	RO
1	Wall/Floor Stop	401/445 As Required	US26D	RO
3	Silencer	608		RO

Set: 28.0

3	Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK
1	Mortise Lock (storeroom)	76 8204 LNL	US32D	SA
1	Surface Closer	281 O	EN	SA
1	Kick Plate	K1050 8" 4BE CSK	US32D	RO
1	Wall/Floor Stop	401/445 As Required	US26D	RO
3	Silencer	608		RO

Set: 29.0

3	Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK
1	Mortise Lock (storeroom)	76 8204 LNL	US32D	SA
1	Surface Closer	281 P10	EN	SA
1	Kick Plate	K1050 8" 4BE CSK	US32D	RO

1	Wall/Floor Stop	401/445 As Required	US26D	RO
3	Silencer	608		RO

Set: 30.0

3	Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK
1	Mortise Lock (storeroom)	76 8204 LNL	US32D	SA
1	Surface Closer (stop)	281 CPS	EN	SA
1	Kick Plate	K1050 8" 4BE CSK	US32D	RO
3	Silencer	608		RO

Set: 31.0

3	Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK
1	Mortise Lock (storeroom)	76 8204 LNL	US32D	SA
1	Surface Overhead Stop	1540S Series	US26D	SA
1	Surface Closer	281 P3	EN	SA
1	Kick Plate	K1050 8" 4BE CSK	US32D	RO
3	Silencer	608		RO

Mount door closer foot on opposite rabbet to avoid conflict with over head stop.

Set: 32.0

1	Continuous Hinge	CFM HD1	CL	MK
1	Mortise Lock (storeroom)	76 8204 LNL	US32D	SA
1	Surface Closer	281 P10	EN	SA
1	Wall/Floor Stop	401/445 As Required	US26D	RO
1	Perimeter Gasket	S88		PE
1	Threshold	2005AT		PE

Cylinder to be on inside face of door.

Set: 33.0

6	Hinge (heavy weight)	T4A3786 4-1/2" x 4-1/2"	US26D	MK
2	Flush Bolt	555	US26D	RO
1	Dust Proof Strike	570	US26D	RO
1	Mortise Lock (storeroom)	76 8204 LNL	US32D	SA
1	Surface Closer	281 O	EN	SA
2	Kick Plate	K1050 8" 4BE CSK	US32D	RO
2	Wall/Floor Stop	401/445 As Required	US26D	RO
1	Astragal	357SP		PE
2	Silencer	608		RO

Set: 34.0

6	Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK
2	Flush Bolt	555	US26D	RO
1	Dust Proof Strike	570	US26D	RO
1	Mortise Lock (storeroom)	76 8204 LNL	US32D	SA
1	Surface Overhead Stop	1540S Series	US26D	SA
1	Surface Closer (stop)	281 CPS	EN	SA
2	Kick Plate	K1050 8" 4BE CSK	US32D	RO
2	Silencer	608		RO

Set: 35.0

6	Hinge (heavy weight)	T4A3786 4-1/2" x 4-1/2"	US26D	MK
2	Flush Bolt	555	US26D	RO
1	Dust Proof Strike	570	US26D	RO
1	Mortise Lock (exit only)	8213 7/8" Lip Length LNL	US32D	SA
1	Surface Closer	281 O	EN	SA
2	Kick Plate	K1050 8" 4BE CSK	US32D	RO
2	Wall/Floor Stop	401/445 As Required	US26D	RO
2	Silencer	608		RO
1	Astragal	357SP		PE

Set: 36.0

3	Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK
1	Mortise Lock (passage)	8215 LNL	US32D	SA
1	Surface Closer (stop)	281 CPS	EN	SA
1	Kick Plate	K1050 8" 4BE CSK	US32D	RO
3	Silencer	608		RO

Set: 37.0

3	Hinge (heavy weight)	T4A3786 4-1/2" x 4-1/2"	US26D	MK
1	Mortise Lock (passage)	8215 LNL	US32D	SA
1	Surface Closer (stop)	281 CPS	EN	SA
1	Kick Plate	K1050 8" 4BE CSK	US32D	RO
3	Silencer	608		RO

Set: 38.0

3	Hinge (heavy weight)	T4A3786 4-1/2" x 4-1/2"	US26D	MK
1	Mortise Lock (passage)	8215 LNL	US32D	SA
1	Surface Closer (stop)	281 CPS	EN	SA
1	Kick Plate	K1050 8" 4BE CSK	US32D	RO
1	Perimeter Gasket	S88		PE
1	Mortise Auto Door Bottom	434ARL/420ASL As Required		PE

Set: 39.0

3	Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK
1	Mortise Lock (passage)	8215 LNL	US32D	SA
1	Surface Closer (stop)	281 CPS	EN	SA
1	Kick Plate	K1050 8" 4BE CSK	US32D	RO
1	Perimeter Gasket	S773		PE
1	Mortise Auto Door Bottom	434ARL/420ASL As Required		PE
1	Threshold	173A MSES10SS (Door 103A.1)		PE

Set: 40.0

3	Hinge (heavy weight)	T4A3786 4-1/2" x 4-1/2"	US26D	MK
1	Mortise Deadlock (classroom)	4877	US32D	SA
1	Push Pull	111x73C/73CL CFC CFTT	US32D	RO
1	Surface Closer	281 O	EN	SA
1	Kick Plate	K1050 8" 4BE CSK	US32D	RO

1	Wall/Floor Stop	401/445 As Required	US26D	RO
3	Silencer	608		RO

Set: 41.0

3	Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK
1	Mortise Lock (privacy)	8266 LNL	US32D	SA
1	Surface Closer	281 O	EN	SA
1	Kick Plate	K1050 8" 4BE CSK	US32D	RO
1	Wall/Floor Stop	401/445 As Required	US26D	RO
3	Silencer	608		RO

Set: 42.0

3	Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK
1	Mortise Lock (entry)	8256 LNL	US32D	SA
1	Surface Closer (stop)	281 P10	EN	SA
1	Kick Plate	K1050 8" 4BE CSK	US32D	RO
1	Wall/Floor Stop	401/445 As Required	US26D	RO
3	Silencer	608		RO

Set: 43.0

3	Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK
1	Mortise Lock (office)	8205 LNL	US32D	SA
1	Wall/Floor Stop	401/445 As Required	US26D	RO
3	Silencer	608		RO

Set: 44.0

3	Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK
1	Mortise Lock (passage)	8215 LNL	US32D	SA
1	Surface Closer	281 O	EN	SA
1	Kick Plate	K1050 8" 4BE CSK	US32D	RO
1	Wall/Floor Stop	401/445 As Required	US26D	RO
3	Silencer	608		RO

Set: 45.0

3	Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK
1	Mortise Lock (passage)	8215 LNL	US32D	SA
1	Surface Closer (holder)	281 H	EN	SA
1	Kick Plate	K1050 8" 4BE CSK	US32D	RO
1	Wall/Floor Stop	401/445 As Required	US26D	RO
3	Silencer	608		RO

Set: 46.0

3	Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK
1	Mortise Lock (entry)	8237 LNL	US32D	SA
1	Wall/Floor Stop	401/445 As Required	US26D	RO
3	Silencer	608		RO

Set: 47.0

3	Hinge (heavy weight)	T4A3786 4-1/2" x 4-1/2"	US26D	MK
1	Mortise Lock (entry)	8256 LNL	US32D	SA
1	Surface Closer	281 O	EN	SA
1	Kick Plate	K1050 8" 4BE CSK	US32D	RO
1	Wall/Floor Stop	401/445 As Required	US26D	RO
3	Silencer	608		RO

Set: 48.0

3	Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK
1	Mortise Lock (entry)	8256 LNL	US32D	SA
1	Surface Closer (stop)	281 CPS	EN	SA
1	Kick Plate	K1050 8" 4BE CSK	US32D	RO
3	Silencer	608		RO

Set: 49.0

3	Hinge (heavy weight)	T4A3786 4-1/2" x 4-1/2"	US26D	MK
1	Mortise Lock (entry)	8256 LNL	US32D	SA
1	Surface Closer	281 O	EN	SA
1	Kick Plate	K1050 8" 4BE CSK	US32D	RO
1	Wall/Floor Stop	401/445 As Required	US26D	RO
3	Silencer	608		RO

Set: 50.0

3	Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK
1	Mortise Lock (entry)	8256 LNL	US32D	SA
1	Concealed Overhead Holder/Stop	1530H Series	US26D	SA
1	Surface Closer	281 O	EN	SA
1	Kick Plate	K1050 8" 4BE CSK	US32D	RO
3	Silencer	608		RO

Set: 51.0

3	Hinge (heavy weight)	T4A3786 4-1/2" x 4-1/2"	US26D	MK
1	Mortise Lock (entry)	8256 LNL	US32D	SA
1	Concealed Overhead Stop	1530S Series	US26D	SA
1	Surface Closer	281 O	EN	SA
1	Kick Plate	K1050 8" 4BE CSK	US32D	RO
3	Silencer	608		RO

Set: 52.0

3	Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK
1	Mortise Lock (entry)	8256 LNL	US32D	SA
1	Surface Closer (stop)	281 CPS	EN	SA
1	Kick Plate	K1050 8" 4BE CSK	US32D	RO
3	Silencer	608		RO

Set: 53.0

3	Hinge (heavy weight)	T4A3786 4-1/2" x 4-1/2"	US26D	MK
1	Mortise Lock (entry)	8256 LNL	US32D	SA
1	Surface Closer (stop)	281 CPS	EN	SA

1	Kick Plate	K1050 8" 4BE CSK	US32D	RO
3	Silencer	608		RO

Set: 54.0

6	Hinge (heavy weight)	T4A3786 4-1/2" x 4-1/2"	US26D	MK
2	Flush Bolt	555	US26D	RO
1	Dust Proof Strike	570	US26D	RO
1	Mortise Lock (entry)	8256 LNL	US32D	SA
1	Concealed Overhead Stop	1530S Series	US26D	SA
1	Surface Closer	281 O	EN	SA
2	Kick Plate	K1050 8" 4BE CSK	US32D	RO
2	Silencer	608		RO

Set: 55.0

6	Hinge (heavy weight)	T4A3786 4-1/2" x 4-1/2"	US26D	MK
2	Flush Bolt	555	US26D	RO
1	Dust Proof Strike	570	US26D	RO
1	Mortise Lock (entry)	8256 LNL	US32D	SA
1	Concealed Overhead Stop	1530S Series	US26D	SA
1	Surface Closer (stop)	281 CPS	EN	SA
2	Kick Plate	K1050 8" 4BE CSK	US32D	RO
2	Silencer	608		RO

Set: 56.0

3	Hinge (heavy weight)	T4A3786 4-1/2" x 4-1/2"	US26D	MK
1	Mortise Lock (entry)	8256 LNL	US32D	SA
1	Surface Closer	281 O	EN	SA
1	Kick Plate	K1050 8" 4BE CSK	US32D	RO
1	Wall/Floor Stop	401/445 As Required	US26D	RO
1	Perimeter Gasket	S773		PE
1	Mortise Auto Door Bottom	434ARL/420ASL As Required		PE

Set: 57.0

3	Hinge (heavy weight)	T4A3786 4-1/2" x 4-1/2"	US26D	MK
1	Mortise Lock (entry)	8256 LNL	US32D	SA
1	Concealed Overhead Stop	1530S Series	US26D	SA
1	Surface Closer	281 O	EN	SA
1	Kick Plate	K1050 8" 4BE CSK	US32D	RO
1	Perimeter Sound Gasket	S773		PE
1	Mortise Auto Door Bottom	434ARL/420ASL As Required		PE

Set: 58.0

3	Hinge (heavy weight)	T4A3786 4-1/2" x 4-1/2"	US26D	MK
1	Mortise Lock (entry)	8256 LNL	US32D	SA
1	Surface Closer (stop)	281 CPS	EN	SA
1	Kick Plate	K1050 8" 4BE CSK	US32D	RO
1	Perimeter Gasket	S88		PE
1	Mortise Auto Door Bottom	434ARL/420ASL As Required		PE

Set: 59.0

2 Flush Bolt	555	US26D	RO
1 Dust Proof Strike	570	US26D	RO
1 Mortise Lock (entry)	8256 LNL	US32D	SA
1 Surface Closer	281 O	EN	SA
2 Floor Stop	480	US26D	RO
1 Threshold	173A MSES10SS		PE
1 Balance of Hardware	By Acoustic Door Supplier		

Set: 60.0

6 Hinge (heavy weight)	T4A3786 4-1/2" x 4-1/2"	US26D	MK
2 Flush Bolt	555	US26D	RO
1 Dust Proof Strike	570	US26D	RO
1 Mortise Lock (entry)	8256 LNL	US32D	SA
1 Concealed Overhead Stop	1530S Series	US26D	SA
1 Surface Closer (stop)	281 CPS	EN	SA
2 Kick Plate	K1050 8" 4BE CSK	US32D	RO
1 Astragal	357SS		PE
1 Perimeter Sound Gasket	S773		PE
2 Mortise Auto Door Bottom	434ARL/420ASL As Required		PE

Set: 61.0

3 Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK
1 Mortise Lock (passage)	8215 LNL	US32D	SA
1 Surface Closer	281 O	EN	SA
1 Kick Plate	K1050 8" 4BE CSK	US32D	RO
1 Wall/Floor Stop	401/445 As Required	US26D	RO
1 Perimeter Sound Gasket	S773		PE
1 Mortise Auto Door Bottom	434ARL/420ASL As Required		PE

Set: 62.0

3 Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK
1 Mortise Lock (classroom)	76 8237 LNL	US32D	SA
1 Surface Closer	281 O	EN	SA
1 Kick Plate	K1050 8" 4BE CSK	US32D	RO
1 Wall/Floor Stop	401/445 As Required	US26D	RO
3 Silencer	608		RO

Set: 63.0

3 Hinge (heavy weight)	T4A3786 4-1/2" x 4-1/2"	US26D	MK
1 Mortise Lock (classroom)	76 8237 LNL	US32D	SA
1 Concealed Overhead Stop	1530S Series	US26D	SA
1 Surface Closer	281 O	EN	SA
1 Kick Plate	K1050 8" 4BE CSK	US32D	RO
1 Wall/Floor Stop	401/445 As Required	US26D	RO
1 Perimeter Sound Gasket	S773		PE
1 Mortise Auto Door Bottom	434ARL/420ASL As Required		PE

Set: 64.0

3 Hinge (heavy weight)	T4A3786 4-1/2" x 4-1/2"	US26D	MK

1 Mortise Lock (classroom)	76 8237 LNL	US32D	SA
1 Concealed Overhead Stop	1530S Series	US26D	SA
1 Surface Closer	281 O	EN	SA
1 Kick Plate	K1050 8" 4BE CSK	US32D	RO
1 Wall/Floor Stop	401/445 As Required	US26D	RO
3 Silencer	608		RO

Set: 65.0

6 Hinge (heavy weight)	T4A3786 4-1/2" x 4-1/2"	US26D	MK
2 Multipoint Lock (passage)	12 NB7015 ETL	US26D	SA
2 EM Floor Holder	980	689	RF
2 Surface Closer	281 P10	EN	SA
2 Kick Plate	K1050 8" 4BE CSK	US32D	RO
2 Silencer	608		RO
2 Concealed Door Contact	Section 28 13 00		

Set: 66.0

3 Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK
1 Mortise Lock (passage)	8215 LNL	US32D	SA
1 Surface Closer (stop)	281 CPS	EN	SA
1 Kick Plate	K1050 8" 4BE CSK	US32D	RO
1 Perimeter Gasket	S88		PE
1 Mortise Auto Door Bottom	434ARL/420ASL As Required		PE
1 Concealed Door Contact	Section 28 13 00		

Set: 67.0

3 Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK
1 Mortise Lock (passage)	8215 LNL	US32D	SA
1 Surface Closer (stop)	281 CPS	EN	SA
1 Kick Plate	K1050 8" 4BE CSK	US32D	RO
3 Silencer	608		RO
1 Concealed Door Contact	Section 28 13 00		

Set: 68.0

3 Hinge (heavy weight)	T4A3786 4-1/2" x 4-1/2"	US26D	MK
1 Mortise Lock (classroom)	76 8237 LNL	US32D	SA
1 Surface Closer	281 CPS	EN	SA
1 Kick Plate	K1050 8" 4BE CSK	US32D	RO
3 Silencer	608		RO

Set: 69.0

3 Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK
1 Mortise Lock (passage)	8215 LNL CPC	US32D	SA
1 Surface Closer (stop)	281 O	EN	SA
1 Wall/Floor Stop	401/445 As Required	US26D	RO
3 Silencer	608		RO
1 Concealed Door Contact	Section 28 13 00		

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Electrically operated and controlled door operators.

1.2 RELATED REQUIREMENTS

B. Related work for automatic door operators includes:
1. Section 06 10 00 – Rough Carpentry
2. Section 06 20 00 – Finish Carpentry
3. Section 07 90 05 – Joint Sealers
4. Section 08 11 13 – Hollow Metal Doors and Frames
5. Section 08 43 13 – Aluminum-Framed Storefronts
6. Section 08 71 00 – Door Hardware
7. Section 09 21 16 – Gypsum Board Assemblies

1.3 REFERENCE STANDARDS

A. ANSI/ICC A117.1 - American National Standard for Accessible and Usable Buildings Facilities International Code Council; 2003.

B. DHI (LOCS) - Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames; Door and Hardware Institute; 2004.

C. DHI WDHS.3 - Recommended Locations for Architectural Hardware for Flush Wood Doors; Door and Hardware Institute; 1993; also in WDHS-1/WDHS-5 Series, 1996.

D. 2005 Connecticut State Fire Safety Code - “New Construction, Renovation, and Change of Use.”

E. UL (BMD) - Building Materials Directory; Underwriters Laboratories Inc.; current edition.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the manufacture, fabrication, and installation of products onto which door hardware will be installed.

B. Furnish templates for door and frame preparation to manufacturers and fabricators of products requiring internal reinforcement for door hardware.

C. Convey Owner's keying requirements to manufacturers.

D. Preinstallation Meeting: Convene a preinstallation meeting one week prior to commencing work of this section; require attendance by all affected installers.

E. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

1.5 SUBMITTALS

A. See Section 01 33 00 – Submittal Procedures, for submittal procedures.

B. Shop Drawings:

1. Indicate locations and mounting heights of each type of hardware, schedules, catalog cuts, electrical characteristics and connection requirements.
2. Samples: Prior to preparation of hardware schedule:
   a. Submit 1 sample of hinge, latchset, lockset, closer, illustrating style, color, and finish.
   b. Samples will be returned to supplier.
3. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention.
4. Project Record Documents: Record actual locations of concealed equipment, services, and conduit.
5. Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.
6. Warranty: Submit manufacturer's warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
7. Maintenance Materials and Tools: Furnish the following for Owner's use in maintenance of project.
   a. See Section 01 60 00 - Product Requirements, for additional provisions.
   b. Tools: One set of all special wrenches or tools applicable to each different or special hardware component, whether supplied by the hardware component manufacturer or not.

1.6 QUALITY ASSURANCE

A. Standards for Fire-Rated Doors: Maintain one copy of each referenced standard on site, for use by Architect and Contractor.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

C. Hardware Supplier Qualifications: Company specializing in supplying commercial door hardware with 5 years of experience.

D. Hardware Supplier Personnel: Employ an Architectural Hardware Consultant (AHC) to assist in the work of this section.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Package hardware items individually; label and identify each package with door opening code to match hardware schedule.

1.8 WARRANTY

A. See Section 01 77 00 - Closeout Procedures, for additional warranty requirements.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS FOR DOOR HARDWARE PRODUCTS

A. Provide products that comply with the following:
   1. Applicable provisions of federal, state, and local codes.
   2. ANSI/ICC A117.1, American National Standard for Accessible and Usable Buildings and Facilities.
   3. Applicable provisions of NFPA 101, Life Safety Code.

4. Products Requiring Electrical Connection: Listed and classified by UL as suitable for the purpose specified and indicated.

2.2 AUTOMATIC OPERATORS

A. Basis of Design: Gyro Tech equipment as manufactured by NABCO Entrances, Inc. and corresponding components have been listed and referenced as part of the basis of design.

B. Acceptable Manufacturers and Products:
   1. The criteria listed below are performance requirements and specifications for an automatic door operator. Also see Section 01 25 00 –Substitutions Procedures.

C. Meet requirements of disabled in accordance with Federal Regulation ANSI 117.

D. All automatic equipment to comply with ANSI 156.19

E. Automatic swing door system for physically challenged as indicated on door schedule and details.

F. Mode of operation: Spring-close operator shall open door by energizing motor and shall stop by stalling motor against mechanical stop. Door shall close slowly by means of spring energy, closing force shall be controlled by and adjustable hydraulic closer independent of the motor and electric control. Complete automatic door cycle—8 to 20 seconds. Closing speed shall be fully adjustable. Manual door operation shall require less than 12 pounds of force applied to door stile. System shall also operate as manual door in the event of power failure. Hold open time shall be adjustable from 0-60 seconds.

G. Operator housing shall be of aluminum extrusion with finished end caps and shall be prepared for mounting to new or existing door frames. Housing cover shall be removable to provide service access. No plastic covers shall be acceptable. Operator housing shall be 5 ¾ deep, by 6" high, by 36" long. Where doors with operators are adjacent, allow for the option to provide both units within a single housing for a continuous appearance.

H. Finish: Aluminum shall have a standard finish of AA-M12-C22-A41(204R1 Clear) or allow for to match Architect's RAL color match.

I. "GEMINI" Power Operator completely assembled unit shall include silent bevel gear and roller chain transmission. Gears and chain coated with special dry lubricant for extreme temperature conditions. Closer to be an adjustable self-contained, LCN4021, sealed, spring/hydraulic unit. Attached to the transmission system shall be a DC permanent magnet motor. Motor shall operate from electronic control and require less than 3 amps at full power stall. Complete unit shall be mounted with provisions for easy replacement without removing door from pivots or frame.

J. Electrical control: Self-contained computerized unit with all electrical components for proper operation and switching of "GEMIMI" Power Operator. Control shall include time delay, Push-N-Go circuitry. Control shall also include sequential mode and shall have variable opening speed adjustment.

K. Connecting Hardware: Connect Conversion Unit (CUGT-400) drive arm to inswing door with a urethane covered roller, which shall ride in a track fabricated of 6061-T6 aluminum alloy attached to the door rail where required for pull-type operation. Outswing doors shall be connected to the operator by a two piece drive arm with self-aligning rod ends and connecting door bracket for push type operation.

L. Provide wall-mounted actuator switches by the same manufacturer as the operator. Actuators shall be weather-resistant type at exterior applications, flush or surface mounted, engraved with handicap insignia. Field verify locations of wall switches with the Architect prior to installation.

M. Automatic door equipment shall be installed by factory-trained installers in compliance with manufacturer's recommendations.

N. Electrical installer shall furnish and install all conduit and electrical wiring for activating and door operation. A minimum of 5 amperes, 115-volt, A/C, 1-phase circuit shall be furnished for each door operator, terminate and connect to operator control panel in operator housing.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that doors and frames are ready to receive work and dimensions are as indicated on shop drawings.

B. Verify that electric power is available to power operated devices and of the correct characteristics.

3.2 INSTALLATION

A. Install hardware in accordance with manufacturer's instructions and applicable codes.

B. Use templates provided by hardware item manufacturer.

C. Mounting heights for hardware from finished floor to center line of hardware item: As listed in

D. Schedule, unless otherwise noted:
1. For steel doors and frames: Comply with DHI "Recommended Locations for Architectural Hardware for Steel Doors and Frames."
2. For steel doors and frames: See Section 08 11 13.
3. For wood doors: Comply with DHI "Recommended Locations for Architectural Hardware for Wood Flush Doors."

3.3 FIELD QUALITY CONTROL

A. Provide an Architectural Hardware Consultant to inspect installation and certify that hardware and installation has been furnished and installed in accordance with manufacturer's instructions and as specified.

3.4 ADJUSTING

A. Adjust work under provisions of Section 01 77 00 - Closeout Procedures.

B. Adjust hardware for smooth operation.

3.5 PROTECTION

A. Do not permit adjacent work to damage hardware or finish.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Operable vents with motor actuator hardware for opening and closing awning vents for smoke evacuation in glazed aluminum curtainwalls. Labeled on Drawings as “Operable Atrium Smoke Control Wndows.”

B. Related Sections:
1. Section 084410 "Glazed Aluminum Curtain Walls" for units to be installed in exterior curtain wall windows.
2. Section 283111 “Digital Addressable Fire Alarm Systems” for smoke evacuation sequences and controls, and electrical requirements.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide casement windows capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Wind Loads: Compliance is based on testing units representative of those indicated for Project that pass AAMA/WDMA/CSA 101/I.S.2/A440, Uniform Load Structural Test.
   a. Basic Wind Speed: 110 mph, or as required by Code.

B. Actuator Performance: Provide actuator that conforms within the total response time from detection to full fan operation in one hundred twenty (120) seconds or less. Coordinate with Divisions 23 and 26 for total response time and overall system requirements.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, fabrication methods, dimensions of individual components and profiles, hardware, finishes, and operating instructions.

1. Motors: Show nameplate data, ratings, characteristics, and mounting arrangements.

B. Shop Drawings: Include plans, elevations, sections, details, hardware, attachments to other work, operational clearances, installation details, and the following:

1. Mullion details, including reinforcement and stiffeners.
2. Accessories.

3. Window System Operators: Show locations and details for installing operator components, switches, and controls. Indicate motor size, electrical characteristics, drive arrangement, mounting, and grounding provisions.
4. Wiring Diagrams: Power, signal, and control wiring.

C. Samples for Initial Selection: For units with factory-applied color finishes.

1. Include similar Samples of hardware and accessories involving color selection.

D. Delegated-Design Submittal: For windows indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer licensed in the State of Connecticut responsible for their preparation and used to determine the following:

1. For actuator performance in coordination with size and weight of operable vent to meet the one hundred twenty (120) second total response time required for the overall smoke evacuation system.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer and manufacturer.

B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each class, grade, and size of roof window.

C. Warranties: Sample of special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For operating hardware, motors, operator components, switches, controls and finishes to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer capable of fabricating smoke evacuation window operators that meet or exceed performance requirements indicated and of documenting this performance by inclusion in lists and by labels, test reports, and calculations.

B. Installer Qualifications: An installer acceptable to window manufacturer for installation of units required for this Project.

1. Installer's responsibilities include providing professional engineering services needed to assume engineering responsibility including preparation of data for window actuators, including Shop Drawings and Designated Design Submittal, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect actuators and accessories during transit, storage, and handling to prevent damage, and deterioration. Store off ground and covered in a clean, dry, well-ventilated, protected space. Comply with manufacturer's written instructions.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace actuators that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Failure to meet performance requirements.
   b. Structural failures including excessive deflection of chain.
   c. Water leakage or air infiltration.
   d. Faulty operation of hardware.
   e. Deterioration of finishes beyond normal weathering.

2. Warranty Period:
   a. Actuator hardware and accessories: Five years from date of Substantial Completion.
   b. Exterior Finish: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MOTORIZED CHAIN ACTUATOR HARDWARE

A. General: Provide manufacturer's standard hardware, fabricated from a corrosion-resistant material compatible with glazed aluminum curtainwalls complying with AAMA 907; designed to smoothly operate, tightly close, and securely lock casement windows; and sized to accommodate sash weight and dimensions.

1. Hardware Finish: To match Architect’s RAL sample.

B. Operable Vent Operation:

1. Operator and Control: Chain motor operator with stainless steel chain that uncoils and stiffens to open sash; with locking mechanism. Actuators are to be programmable for opening speed and distance, closing speed including the ability to slow down for a specified distance at the end, seal relief (the sash will close tight, then back off a specified amount so as not to over-compress the weather seal), and are fully synchronized (paired motors will never fall out of synchronization due to voltage variation or other factors) and are self-regulating. Actuators are to be able to communicate with building control system.
   a. Operation: Electric.

C. Basis of Design Product: Subject to compliance with requirements, provide product by the following:

1. Manufacturer:
   a. STG Beikirch

2. Authorized Representative:
   a. Functional Fenestration, Inc.
      12612 Crenshaw Blvd.
      Hawthorne, CA 90250
      www.fenestration.net
   b. Attention: Jim Roberts
      Vice President
      Phone: 262-363-9927
      Email: jroberts@fenestration.net

3. Actuator Model: FFI Quasar L #41163M DC 24V UR 600mm/24inch chain Silver Case with electronic overload and limit switches. 300N push/pull force.
   a. Requirements: One (1) per sash.

4. Mounting Brackets: Bracket Kit for Quasar L #83621F.
   a. Description: To be based on design of curtainwall and operable vent. 3/16" shim may be required. Coordinate with curtainwall system.

5. Relay Box: FFI Relay Box
   a. Description: 24 VDC connection to Building management System, 20A capacity.
   b. Requirement: One (1) per each power supply/group of windows.

6. Power Supply: FFI Power Supply
   a. 25 Amp 600 watt UL Din Rail Mountable #TSP-600-124
   b. 10 Amp 240 watt UL Din Rail Mountable #SDR-240-24

7. Sash Locking Feature:
   a. Description: Integral to actuator operation..
   b. Requirement: Each operable vent.

8. Control Box:
   a. #CB-1P-Q28 UL control box with four 7 amp RQ control units
   b. #CB-3G-Q21 UL control box with three 7 amp RQ control units

9. Interface with BMS: #RQ Bridge bi-directional communication

D. Attachment Assembly and Components: Manufacturer's standard.

E. Accessories: Manufacturer's standard as required for complete assembly.

F. Technical Data:
   1. Operating Voltage: 24 VDC
   2. Pressing Force: 300N
   3. Locking pressure: 2x3000N
   4. Electrical Connection: Two-pole plug-in screw terminal.
   5. Cut-off "Open": Built-in limit switch.
   6. Cut-off "Closed": Integrated electronic parallel power cut-off.
   7. Operating Time: EM-189-EM-810 – approximately 11 seconds/100mm stroke.
   8. Hook-out Mechanics: Stainless steel chain, maintenance free.
   9. Housing material: Aluminum.
   10. End caps: Aluminum casting in motor color.

2.2 FABRICATION

A. Fabricate windows in sizes indicated on Drawings. Include a complete system for assembling components and meeting the requirements of the smoke evacuation system.

B. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation. Allow for scribing, trimming, and fitting at Project site.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work. Verify rough opening dimensions and operational clearances.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's written installation instructions for installing roof actuators, hardware, accessories, and other components.

B. Install actuators square, true, within the operable vent. Securely anchor without impeding movement and in proper relation to adjacent construction.

C. Separate aluminum, copper, and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials according to recommendations in ASTM E 2112.

3.3 TESTING

A. Comply with time, sequencing and control requirements as described in 283111 “Digital Addressable Fire Alarm Systems.”

B. Provide written description of field tests to meet smoke evacuation requirements. Testing to be coordinated with the authorities having jurisdiction. Manufacturer’s representative and system installer are to be present during testing of completed system.

3.4 ADJUSTING, CLEANING, AND PROTECTION

A. Lubricate hardware and moving parts.

B. Adjust operating sash, actuators, and accessories for a tight fit at contact points and for smooth operation and weathertight closure.

C. Adjust hardware for proper alignment, smooth operation, and proper latching without unnecessary force or excessive clearance.

D. Clean frame surfaces immediately after installing roof windows. Comply with manufacturer's written instructions for final cleaning and maintenance. Avoid damaging protective coatings and finishes.

E. Clean glass immediately after installing actuators. Comply with manufacturer's written instructions for final cleaning and maintenance. Remove nonpermanent labels and clean surfaces.

F. Protect window and aluminum surfaces from contact with contaminating substances resulting from construction operations. If contaminating substances window surfaces, remove contaminants immediately according to manufacturer's written instructions.

G. Replace damaged components.

END OF SECTION 086100

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Glass and glazing for the following products and applications:
   a. Glass infill at railings specified in Section 05 73 00 - DECORATIVE METAL RAILINGS.
   b. Steel doors, frames and sidelights specified in Section 08 11 10 - HOLLOW METAL DOORS AND FRAMES.
   c. Wood doors specified in Section 08 14 00 - FLUSH WOOD DOORS.
   d. Sound-control steel door and frame assemblies in Section 08 34 70 - SOUND-CONTROL DOOR ASSEMBLIES
   e. Glazed entrances specified in Section 08 41 10 - ALUMINUM-FRAMED ENTRANCES.
   f. Glazed curtain walls specified in Section 08 44 10 - GLAZED ALUMINUM CURTAIN WALLS.
   g. Fire-rated glazed curtain walls specified in Section 08 44 16 - FIRE-RATED GLAZED STEEL CURTAIN WALL SYSTEM.
   h. Skylights specified in Section 08 63 00 - METAL-FRAMED SKYLIGHTS.
   i. Interior borrowed lites.
   j. Interior acoustic window and door assemblies.
   k. Unframed mirrors.
   l. Glazing film.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 08 51 10 - ALUMINUM WINDOWS for factory glazing for metal windows.

1.3 DEFINITIONS

A. Manufacturers of Glass Products: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.

C. Interspace: Space between lites of an insulating-glass unit that contains dehydrated air or a specified gas.

D. Deterioration of Coated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in metallic coating.

E. Deterioration of Insulating Glass: Failure of hermetic seal under normal use that is attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

F. Deterioration of Laminated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1.4 PERFORMANCE REQUIREMENTS

A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Glass Design: Glass thickness designations indicated are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites in the thickness designations indicated for various size openings, but not less than thicknesses and in strengths (annealed or heat treated) required to meet or exceed the following criteria:

1. Glass Thicknesses: Select minimum glass thicknesses to comply with ASTM E 1300, according to the following requirements:

a. Specified Design Wind Loads: As required by Code and as specified on Structural Drawings.
b. Specified Design Snow Loads for Sloped Glazing: As required by Code.
c. Probability of Breakage for Vertical Glazing: 8 lites per 1000 for lites set vertically or not more than 15 degrees off vertical and under wind action.

1) Load Duration: 60 seconds or less.

d. Probability of Breakage for Sloped Glazing: 1 lite per 1000 for lites set more than 15 degrees off vertical and under wind and snow action.

1) Load Duration: 30 days.

e. Maximum Lateral Deflection: For the following types of glass supported on all 4 edges, provide thickness required that limits center deflection at design wind pressure to 1/50 times the short side length or 1 inch, whichever is less.

1) For monolithic-glass lites heat-treated to resist wind loads.
2) For insulating glass.
3) For laminated-glass lites.

f. Minimum Glass Thickness for Exterior Lites: Not less than 6 mm.

C. Thermal Movements: Provide glazing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures acting on glass framing members and glazing components. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

D. Thermal and Optical Performance Properties: Provide glass with performance properties specified based on manufacturer's published test data, as determined according to procedures indicated below:

1. For monolithic-glass lites, properties are based on units with lites 6.0 mm thick.
2. For laminated-glass lites, properties are based on products of construction indicated.
3. For insulating-glass units, properties are based on units with lites 6.0 mm thick and a nominal 1/2-inch-wide interspace.
4. Center-of-Glass Values: Based on using LBL-44789 WINDOW 5.0 computer program for the following methodologies:

a. U-Factors: NFRC 100 expressed as Btu/ sq. ft. x h x deg F.
b. Solar Heat Gain Coefficient: NFRC 200.
c. Solar Optical Properties: NFRC 300.

1.5 SUBMITTALS

A. Product Data: For each glass product and glazing material indicated.

B. LEED Submittals:

1. Credit IEQ 4.1: Manufacturers' product data for interior adhesives, sealants and sealant primers, including printed statement of VOC content.

C. Samples: For the following products, in the form of 12-inch- square Samples for glass.

1. Each type of patterned glass.
2. Coated vision glass.
3. Ceramic-coated spandrel glass.
4. Each pattern and color of ceramic-coated vision glass.
5. Fire-resistive glazing products.
6. Each type of laminated glass with colored and patterned interlayer.
7. Insulating glass for each designation indicated.
8. For each color (except black) of exposed glazing sealant indicated.

D. Glazing Schedule: Use same designations indicated on Drawings for glazed openings in preparing a schedule listing glass types and thicknesses for each size opening and location.

E. Product Certificates: Signed by manufacturers of glass and glazing products certifying that products furnished comply with requirements.

1. For solar-control low-e-coated glass, provide documentation demonstrating that manufacturer of coated glass is certified by coating manufacturer.

F. Qualification Data: For installers.

G. Preconstruction Adhesion and Compatibility Test Report: From glazing sealant manufacturer indicating glazing sealants were tested for adhesion to glass and glazing channel substrates and for compatibility with glass and other glazing materials.

H. Product Test Reports: For each of the following types of glazing products:

1. Coated float glass.
2. Fire-resistive glazing products.
3. Insulating glass.
4. Glazing sealants.
5. Glazing gaskets.

I. Warranties: Special warranties specified in this Section.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in glass installations with a record of successful in-service performance..

B. Source Limitations for Glass: Obtain the following through one source from a single manufacturer for each glass type: clear float glass, laminated glass and insulating glass.

C. Source Limitations for Glass Sputter-Coated with Solar-Control Low-E Coatings: Where solar-control low-e coatings of a primary glass manufacturer that has established a certified fabricator program is specified, obtain sputter-coated solar-control low-e-coated glass in fabricated units from a manufacturer that is certified by coated-glass manufacturer.

D. Source Limitations for Glazing Accessories: Obtain glazing accessories through one source from a single manufacturer for each product and installation method indicated.

E. Elastomeric Glazing Sealant Product Testing: Obtain sealant test results for product test reports in "Submittals" Article from a qualified testing agency based on testing current sealant formulations within a 36-month period.

1. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated, as documented according to ASTM E 548.
2. Test elastomeric glazing sealants for compliance with requirements specified by reference to ASTM C 920, and where applicable, to other standard test methods.

F. Preconstruction Adhesion and Compatibility Testing: Submit to elastomeric glazing sealant manufacturers, for testing indicated below, samples of each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member that will contact or affect elastomeric glazing sealants:

1. Use ASTM C 1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
2. Submit not fewer than eight pieces of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
4. For materials failing tests, obtain sealant manufacturer's written instructions for corrective measures, including the use of specially formulated primers.
5. Testing will not be required if elastomeric glazing sealant manufacturers submit data based on previous testing of current sealant products for adhesion to, and compatibility with, glazing materials matching those submitted.

G. Glazing for Fire-Rated Assemblies: Glazing for assemblies that comply with NFPA 80 and that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252 for door assemblies and NFPA 257 for window assemblies.

H. Safety Glazing Products: Comply with testing requirements in 16 CFR 1201.

1. Subject to compliance with requirements, obtain safety glazing products permanently marked with certification label of the Safety Glazing Certification Council or another certification agency] acceptable to authorities having jurisdiction.
2. Where glazing units, including Kind FT glass and laminated glass, are specified in Part 2 articles for glazing lites more than 9 sq. ft. in exposed surface area of one side, provide glazing products that comply with Category II materials, for lites 9 sq. ft. or less in exposed surface area of one side, provide glazing products that comply with Category I or II materials, except for hazardous locations where Category II materials are required by 16 CFR 1201 and regulations of authorities having jurisdiction.

I. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. GANA Publications: GANA Laminated Division's "Laminated Glass Design Guide" and GANA's "Glazing Manual."
2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR-A7, "Sloped Glazing Guidelines."
3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Sloped Glazing Guidelines."
4. IGMA Publication for Insulating Glass: SIGMA TM-3000, "Glazing Guidelines for Sealed Insulating Glass Units."

J. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the following testing and inspecting agency:

1. Insulating Glass Certification Council.

K. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockup for types of windows indicated, in locations shown on Drawings.

L. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. For insulating-glass units that will be exposed to substantial altitude changes, comply with insulating-glass manufacturer's written recommendations for venting and sealing to avoid hermetic seal ruptures.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. Do not install liquid glazing sealants when ambient and substrate temperature conditions are outside limits permitted by glazing sealant manufacturer or below 40 deg F.

1.9 WARRANTY

A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form, made out to the Owner and signed by coated-glass manufacturer agreeing to replace coated-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

1. Warranty Period: Ten years from date of Substantial Completion.

B. Manufacturer's Special Warranty on Laminated Glass: Manufacturer's standard form, made out to the Owner and signed by laminated-glass manufacturer agreeing to replace laminated-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

1. Warranty Period: Five years from date of Substantial Completion.

C. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form, made out to the Owner and signed by insulating-glass manufacturer agreeing to replace insulating-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

1. Warranty Period: Ten years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 EXTERIOR GLAZING SCHEDULE

A. Glazing Type 1: 1 in. Insulated Glazing (TYPE GL-1):

1. Outdoor Lite: 1/4 in. clear, heat strengthened, low-e on No. 2 surface.
2. Interspace: 1/2 in. argon filled.
3. Indoor Lite: 1/4 in. clear, heat strengthened.
4. Overall Thickness: 1 in.
5. Safety where required.

B. Glazing Type 2: 1 in. Insulated Spandrel Glazing (TYPE GL-2):

1. Outdoor Lite: 1/4 in. clear, heat strengthened, low-e on No. 2 surface.
2. Interspace: 1/2 in. argon filled.
3. Indoor Lite: 1/4 in. ceramic coated, heat strengthened.
4. Overall Thickness: 1 in.
5. Spandrel Color: As selected by Architect.
6. Safety where required.

C. Glazing Type 3A: 1 in. Insulated Spandrel Glazing with Frit Pattern 1 (TYPE GL-3A):

1. Outdoor Lite: 1/4 in. clear, heat strengthened, low-e and frit pattern 1 on No. 2 surface.
2. Interspace: 1/2 in. argon filled.
3. Indoor Lite: 1/4 in. ceramic coated, heat strengthened.
4. Overall Thickness: 1 in.
5. Frit Color: As selected by Architect.
6. Frit Pattern: Gradient frit as selected by the Architect.
7. Safety where required.

D. Glazing Type 3B: 1 in. Insulated Spandrel Glazing with Frit Pattern 2 (TYPE GL-3B):

1. Outdoor Lite: 1/4 in. clear, heat strengthened, low-e and frit pattern 2 on No. 2 surface.
2. Interspace: 1/2 in. argon filled.
3. Indoor Lite: 1/4 in. ceramic coated, heat strengthened.
4. Overall Thickness: 1 in.
5. Frit Color: As selected by Architect.
6. Frit Pattern: Gradient frit as selected by the Architect.
7. Safety where required.

E. Glazing Type 4A: 1 in. Insulated Glazing with Frit Pattern 1 (TYPE GL-4A):

1. Outdoor Lite: 1/4 in. clear, heat strengthened, low-e and frit pattern 1 on No. 2 surface.
2. Interspace: 1/2 in. argon filled.
3. Indoor Lite: 1/4 in. clear, heat strengthened.
4. Overall Thickness: 1 in.
5. Frit Color: As selected by Architect.
6. Frit Pattern: Gradient frit as selected by Architect.
7. Safety where required.

F. Glazing Type 4B: 1 in. Insulated Glazing with Frit Pattern 2 (TYPE GL-4B):

1. Outdoor Lite: 1/4 in. clear, heat strengthened, low-e and frit pattern 2 on No. 2 surface.
2. Interspace: 1/2 in. argon filled.
3. Indoor Lite: 1/4 in. clear, heat strengthened.
4. Overall Thickness: 1 in.
5. Spandrel Color: As selected by Architect.
6. Frit Color: As selected by Architect.
7. Frit Pattern: As selected by Architect.
8. Safety where required.

G. Glazing Type 4C: 1 in. Insulated Glazing with Frit Pattern 3 (TYPE GL-4C):

1. Outdoor Lite: 1/4 in. clear, heat strengthened, low-e and frit pattern 3 on No. 2 surface.
2. Interspace: 1/2 in. argon filled.
3. Indoor Lite: 1/4 in. clear, heat strengthened.
4. Overall Thickness: 1 in.
5. Spandrel Color: As selected by Architect.
6. Frit Color: As selected by Architect.
7. Frit Pattern: As selected by Architect.
8. Safety where required.

H. Glazing Type 5: Not Used.

I. Glazing Type 6: 1 in. Insulated Glazing 45 Minute Fire-Rated (TYPE GL-6):

1. Outdoor Lite: 1/4 in. clear, heat strengthened, low-e on No. 2 surface.
2. Interspace: 9/16 in. argon filled.
3. Indoor Lite: 5/16 in. fire-rated laminated safety glazing.
4. Overall Thickness: 1 in.

J. Glazing Type 7: 1 in. Insulated Spandrel Glazing 45 Minute Fire-Rated (TYPE GL-7):

1. Outdoor Lite: 1/4 in. clear, heat strengthened, low-e on No. 2 surface.
2. Interspace: 9/16 in. argon filled.
3. Indoor Lite: 5/16 in. fire-rated laminated safety spandrel glazing.
4. Overall Thickness: 1 in.
5. Spandrel Color: As selected by Architect.

K. Glazing Type 8 at Skylight: 1-3/8 in. Insulating Laminated Glass (TYPE GL-8):

1. Outdoor Lite: 3/8 in. clear, heat strengthened, low-e on No. 2 surface.
2. Interspace: 1/2 in. argon filled.
3. Indoor Lite: 1/2 in. (2 lites at 1/4 in. each) 1 clear layer and 1 tinted layer, 0.030 interlayer laminated, both lites heat strengthened.
4. Overall Thickness: 1-1/4 in.
5. Tinted glazing Color: As selected by Architect.

2.2 INSULATING-GLASS UNITS

A. Insulating-Glass Units for Vertical Glazing: Provide the following or equal:

1. Basis-of-Design: Solarban 70XL by PPG Industries.

2.3 GLASS PRODUCTS

A. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.

B. Heat-Treated Float Glass: ASTM C 1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
2. For uncoated glass, comply with requirements for Condition A.
3. For coated vision glass, comply with requirements for Condition C (other coated glass).

C. Tempered Float Glass: ASTM C 1048; Type I (transparent flat glass); Quality-Q3; Kind FT; 1/4 inch thick unless indicated otherwise.

D. Patterned Glass: ASTM C 1036, Type II (patterned and wired flat glass), Class 1 (clear), Form 3 (patterned); and of quality, finish, and pattern specified.

E. Laminated Glass: ASTM C 1172, and complying with testing requirements in 16 CFR 1201 for Category II materials, and with other requirements specified. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.

1. Construction for Framed Units: Laminate glass with polyvinyl butyral interlayer to comply with interlayer manufacturer's written recommendations.
2. Construction for Units with Exposed Edges: Laminate glass with cast-in-place and cured-transparent-resin interlayer to comply with interlayer manufacturer's written recommendations.
3. Interlayer Thickness: 0.030 in. thick for vertical glazing, 0.060 in. thick for sloped glazing.
4. Interlayer Color: Clear unless otherwise indicated.

F. Fire-Rated Monolithic Ceramic Glazing Material (Not for Temperature-Rise-Rated Doors): Proprietary product in the form of clear flat sheets of 3/16-inch nominal thickness weighing 2.5 lb/sq. ft. and as follows:

1. Fire-Protection Rating: As indicated for the fire window in which glazing material is installed, and permanently labeled by a testing and inspecting agency acceptable to authorities having jurisdiction.
2. Basis-of-Design: "Premium FireLite" (polished on both surfaces) by Nippon Electric Glass Co., Ltd., and distributed by Technical Glass Products.

G. Fire-Rated Laminated Ceramic Glazing Material (Not for Temperature-Rise-Rated Doors): Proprietary Category II safety glazing product in the form of 2 lites of clear ceramic glazing material laminated together to produce a laminated lite of 5/16-inch nominal (8.0 mm) thickness; polished on both surfaces; weighing 4 lb/sq. ft. and as follows:

1. Fire-Protection Rating: As indicated for the assembly in which glazing material is installed, and permanently labeled by a testing and inspecting agency acceptable to authorities having jurisdiction.
2. Polished on both surfaces, transparent.
3. Product: "FireLite Plus" by Nippon Electric Glass Co., Ltd., and distributed by Technical Glass Products.

H. Insulating-Glass Units, General: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interpane air space, and complying with ASTM E774 for Class CBA units and with requirements specified in this Section.

1. Provide Kind HS (heat-strengthened) float glass in place of annealed glass where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with glass design requirements specified in Part 1 “Performance Requirements” paragraph.
2. Provide Kind FT (fully tempered) glass lites where safety glass is indicated.
3. Overall Unit Thickness and Thickness of Each Lite: Dimensions indicated for insulating-glass units are nominal and the overall thicknesses of units are measured perpendicularly from outer surfaces of glass lites at unit’s edge.
4. Sealing System: Dual seal, with primary and secondary sealants as follows:
   a. Manufacturer’s Standard Sealants. Butyl primary and silicone secondary sealants. Secondary sealant shall cover entire spacer bar at IGU perimeter.
5. Spacer Specifications: Manufacturer’s standard spacer material. Spacer corners shall be bent, soldered, or welded. Keyed spacer corners will not be accepted. Spacer may have a mid-span spacer key located at the midpoint of the insulating glass unit head. Where a mid-span spacer key is used, the key must be fully embedded (all sides) in butyl sealant.

I. Ceramic-Coated Spandrel Glass: ASTM C 1048, Condition B, Type I, Quality-Q3, and complying with other requirements specified.

1. Glass: Clear float.
2. Ceramic Coating Color: Custom color as selected by the Architect.

J. Ceramic-Coated Vision Glass (Fritted Glass): Heat-treated float glass, Condition C; with ceramic enamel applied by silk-screened process; complying with Specification No. 95-1-31 in GANA's Tempering Division's "Engineering Standards Manual" and with other requirements specified.

1. Glass: Clear float.
2. Ceramic Coating Color and Pattern: As selected by the Architect.

K. Acoustic Glass: Provide laminated glazing with an minimum STC of 50.

1. Window Glass: Units shall consist of 1/4 inch thick laminated glass, 4 in. air space, 1/2 inch laminated glass.
2. Door Glass: Provide laminated glazing with 3/8 inch thick glass and 1/4 inch thick laminated glass.

L. Glass Mirrors, General: ASTM C 1503; manufactured using copper-free, low-lead mirror coating process.

1. Mirror Edge Treatment: Flat polished edge.

2.4 GLAZING SEALANTS

A. General: Provide products of type indicated, complying with the following requirements:

1. Compatibility: Verify glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and

glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.
4. Adhesives and sealants that are used inside the weatherproofing system shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

    a. Structural Glazing Adhesives: 100 g/L.
    b. Architectural Sealants: 250 g/L.

B. Elastomeric Glazing Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

1. Single-Component Neutral- and Basic-Curing Silicone Glazing Sealants:

    a. Dow Corning Corporation; 790.
    b. GE Silicones; SilPruf LM SCS2700.
    c. Tremco Inc.; Spectrem 1.

C. Glazing Sealants for Fire-Resistive Glazing Products: Identical to products used in test assemblies to obtain fire-protection rating.

2.5 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based elastomeric tape with a solids content of 100 percent; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; packaged on rolls with a release paper backing; and complying with ASTM C 1281 and AAMA 800 for project conditions.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; packaged on rolls with release liner protecting adhesive; and complying with AAMA 800 for the following types:

1. Type 1, for glazing applications in which tape acts as the primary sealant.
2. Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.6 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions with a Shore, Type A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

F. Perimeter Insulation for Fire-Resistive Glazing: Identical to product used in test assembly to obtain fire-resistance rating.

G. Mirror Mastic: An adhesive setting compound, asbestos-free, produced specifically for setting mirrors and certified by both mirror manufacturer and mastic manufacturer as compatible with glass coating and substrates on which mirrors will be installed.

H. Mirror Hardware, Top and Bottom Aluminum J-Channels: Aluminum extrusions with a return deep enough to produce a glazing channel to accommodate mirrors of thickness indicated and in lengths required to cover bottom and top edges of each mirror in a single piece.

2.7 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites in a manner that produces square edges with slight kerfs at junctions with outdoor and indoor faces.

C. Grind smooth and polish exposed glass edges and corners.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing glazing, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Presence and functioning of weep system.
3. Minimum required face or edge clearances.
4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Glazing channel dimensions, as indicated on Drawings, provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.

C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.

E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead. Apply sealant, as recommended by manufacturer, at cut glazing gasket glazing covers.

F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

G. Provide spacers for glass lites where length plus width is larger than 50 inches as follows:

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

J. Wall-Mounted Mirrors: Install mirrors with mastic and mirror hardware. Attach mirror hardware securely to mounting surfaces with mechanical fasteners installed with anchors or inserts as applicable. Install fasteners so heads do not impose point loads on backs of mirrors.

K. Glazing Film: Apply squarely aligned to glass edges, uniformly smooth, and free from tears, air bubbles, wrinkles, and rough edges, in single sheet completely overlaying the back face of clean glass, according to manufacturer's written instructions, including surface preparation and application temperature limitations.

3.4 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until just before each glazing unit is installed.

F. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

3.5 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.6 CLEANING AND PROTECTION

A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended by glass manufacturer.

C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

END OF SECTION 08 80 00

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes the following decorative glass for interior applications:

1. Laminated with decorative interlayer glass within the metal railing system at atrium openings and monumental stair.
2. Glass with decorative film overlay at all offices, classrooms, and seminar rooms interior glass.

B. Related Sections:

1. Section 05 73 00 Decorative Metal Railings for glass in metal railings.
2. Section 08 80 00 Glazing for standard glass products.

1.3 DEFINITION

A. Glass Thickness: Indicated by thickness designations in millimeters according to ASTM C 1036.

1.4 PERFORMANCE REQUIREMENTS

A. General Performance: Installed glazing systems shall withstand normal thermal movement and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; deterioration of glazing materials; or other defects in construction.

B. Delegated Design: Design glass installed adjacent to walking surfaces, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1. Differential deflection of adjacent unsupported edges shall not exceed glass thickness when subjected to 50 lbf/ft. (730 N/m) applied horizontally to one panel at any point up to 42 inches (1067 mm) above the adjacent walking surface.
2. Base design on thickness at thinnest part of the glass.

1.5 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Test each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.

1. Use ASTM C 1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
2. Submit no fewer than three Samples of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
4. For materials failing tests, obtain sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.
5. Testing will not be required if data based on previous testing of current sealant products and glazing materials match those submitted.

1.6 ACTION SUBMITTALS

A. Product Data: For each decorative-glass and glazing product indicated including laminated glass interlayer.

B. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For glazing sealants used inside the weatherproofing system, documentation including printed statement of VOC content.
2. Laboratory Test Reports for Credit IEQ 4: For glazing sealants used inside the weatherproofing system, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Shop Drawings: Show fabrication and installation details. Include the following:

1. Size and location of penetrations.
2. Mounting method.
3. Attachments to other work.
4. Full-size details of edge-finished profiles.

D. Glass Samples: For the following products, 12 inches square:

1. Each type of decorative glass.
2. Each edge treatment on type of decorative glass.
3. Each decorative film overlay on type of decorative glass.

E. Product Schedule: (See Product Summary above.)

F. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Product Certificates: For each type of decorative glass, from manufacturer.

C. Preconstruction Adhesion and Compatibility Test Reports: Based on evaluation and comprehensive tests performed by a qualified testing agency, for laminated glass with decorative film interlayer and decorative film overlay.

D. Warranty: Sample of special warranty.

1.8 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of decorative glass and each decorative film overlay to include in maintenance manuals.

1.9 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under NGA's Certified Glass Installer Program.

B. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

C. Source Limitations for Glass: Obtain each type of decorative glass from single source from single manufacturer.

D. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer, for each product and installation method.

E. Glazing Publications: Comply with published recommendations in GANA's "Laminated Glazing Reference Manual" and GANA's "Glazing Manual" unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.

F. Safety Glazing: Where safety glazing is indicated, comply with testing requirements in 16 CFR 1201 for Category II materials.

1. Labeling: Permanently mark glazing with certification label of SGCC Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard that glass complies with.

G. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

H. Preinstallation Conference: Conduct conference at Project site.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Protect decorative glass and glazing materials according to manufacturer's written instructions and as needed to prevent damage to surfaces and edges.

B. Retain packaging and sequencing numbers for decorative-glass units.

1.11 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install decorative glass until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

B. Field Measurements: Verify actual dimensions of openings and construction contiguous with decorative glass by field measurements before fabrication.

1.12 WARRANTY

A. Special Warranty on Laminated Glass: Manufacturer's standard form in which laminated-glass manufacturer agrees to replace laminated-glass units that deteriorates within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1. Warranty Period: 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GLASS PRODUCTS, GENERAL

A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.

B. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass as needed to comply with requirements indicated. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass as needed to comply with requirements indicated. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.

2.2 DECORATIVE GLASS TYPES

A. Decorative Glass: Laminated glass, ASTM C 1172. Use materials that have a proven record of not bubbling, discoloring, or losing physical and mechanical properties after fabrication and installation.

1. Products: Subject to compliance with requirements, provide the following products:

2. Basis-of-Design Interlayer Product: Subject to compliance with requirements, provide **SentryGlas Expressions** as manufactured by a licensed manufacturer.

3. Construction: Two plies of safety float glass.
4. Glass Construction, thickness, and interlayer thickness: to comply with interlayer manufacturer's written recommendations.
5. All options in first subparagraph below are suitable for PVB interlayer. Cured-resin thickness is a function of spacer dimension used during fabrication. GANA's "Laminated Glazing Reference Manual" states that 0.030-inch- (0.76-mm-) thick or thicker PVB or cured resin "may meet the requirements for Category I and II of the CPSC 16 CFR 1202 standard." Verify, with manufacturers, interlayer thickness and safety performance.

6. Comply with requirements for safety glazing.
7. Interlayer Material Color and Pattern: Match Architect's custom samples
8. Visible Light Transmittance of Interlayer: to be selected by Architect..

B. Decorative Glass: Glass with decorative film overlay. Use translucent, dimensionally stable, cast PVC film, 2-mil minimum thickness, with pressure-sensitive, clear adhesive back for adhering to glass and releasable protective backing.

1. Products: Subject to compliance with requirements, provide the following]:
   a. Decorative Films, LLC or equal. Solyx SXGR-Lines 3648 Lines Gradient

2.3 HARDWARE FOR GLASS INSTALLATION

A. Hardware: As required to achieve architectural intent. See drawing details.

B. Fasteners: Fabricated of same basic metal and alloy as fastened metal and matching it in finished color and texture where fasteners are exposed.

C. Gaskets and Wedges: Manufacturer's standard, compatible with decorative glass type indicated.

D. Anchors and Inserts: Provide devices as required for hardware installation. Provide toothed or lead-shield expansion-bolt devices for drilled-in-place anchors. Provide stainless-steel anchors and inserts for applications on inside face of exterior walls and where indicated.

2.4 DECORATIVE-GLASS FABRICATION

A. Fabricate decorative glass and provide other glazing products in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written recommendations of product manufacturer and with referenced glazing standard.

B. Edge Finishing: Fabricate finished edges to produce smooth, polished edges without chips, scratches, or warps.

1. Finished Edge: As selected by Architect from manufacturer’s samples.
2. Edge-Finished Glass Adhesive: Clear, nonyellowing, as recommended by manufacturer.

C. Lite Treatment: as indicated on Drawings with smooth, uniform edge.

D. Decorative Film Overlay: Apply squarely aligned to glass edges, uniformly smooth, and free from tears, air bubbles, wrinkles, and rough edges, with graphic images as indicated on

Architect's samples the back face of clean glass, according to manufacturer's written instructions, including surface preparation and application temperature limitations.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine decorative-glass framing members, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Minimum required face or edge clearances.
3. Effective sealing between joints of decorative-glass framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

B. Examine glazing units to locate orientation of outer surfaces Label or mark units as needed so that surface orientation is readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.3 INSTALLATION

A. Set decorative-glass units in each series true in line with uniform orientation, pattern, draw, bow, and similar characteristics.

B. Set glass lites with proper orientation so that each outer surface faces the direction per Architect's direction.

C. Set decorative glass in locations indicated on Drawings. Install glass with hardware and accessories according to hardware manufacturer's written instructions. Attach hardware securely to mounting surfaces and structure.

D. Set decorative glass in locations indicated on Drawings.

3.4 GLAZING, GENERAL

A. Decorative Glass: Install glazing as specified in Division 08 Section "Glazing."

B. Comply with combined written instructions of manufacturers of gaskets, glass, sealants, tapes, and other glazing materials unless more stringent requirements are indicated, including those in referenced glazing publications.

C. Adjust glazing channel dimensions during installation as required by Project conditions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

D. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

E. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

F. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

G. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

H. Provide spacers for glass lites where length plus width is more than 50 inches (1270 mm).

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances, and to comply with system performance requirements.
2. Provide 1/8-inch (3-mm) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

I. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

END OF SECTION 088113

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Fixed extruded-aluminum louvers and frames.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 042200 - LOAD-BEARING UNIT MASONRY
2. Section 076200 - SHEET META FLASHING AND TRIM for welded pan flashing and sheet membrane flashing.
3. Section 07 92 00 - JOINT SEALANTS for sealants installed in perimeter joints between louver frames and adjoining construction.
4. Division 23 - HEATING, VENTILATING AND AIR CONDITIONING for Cooling Towers louvers.

1.3 DEFINITIONS

A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.

B. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.

1.4 PERFORMANCE REQUIREMENTS

A. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.

B. Structural Performance: Provide louvers capable of withstanding the effects of gravity loads and wind loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver blade rattle or flutter,

or permanent damage to fasteners and anchors. Wind pressures shall be considered to act on vertical projection of louvers. Loads as required by Code.

C. Seismic Performance: Provide louvers capable of withstanding the effects of earthquake motions as required by code.

D. Thermal Movements: Provide louvers that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F ambient; 180 deg F material surfaces.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other Work. Show blade profiles, angles, and spacing.

1. For installed louvers indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.

D. Samples for Verification: For each type of metal finish required.

E. Qualification Data: For professional engineer.

F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain louvers and vents through one source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

B. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.2, "Structural Welding Code--Aluminum."

C. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify louver openings by field measurements before fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating louvers without field measurements. Coordinate construction to ensure that actual opening dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Louvers and Vents:
   a. Airolite Company, LLC.
   b. Construction Specialties, Inc.
   c. Greenheck.
   d. Industrial Louvers, Inc.
   e. McDermott Metal Works Corporation
   f. Nystrom Building Products.
   g. Ruskin Company.

2. Basis-of-Design: Model RS-4300 by Construction Specialties, Inc.

2.2 MATERIALS

A. Aluminum Extrusions: ASTM B 221, alloy 6063-T6.

B. Aluminum Sheet: ASTM B 209, alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.

C. Fasteners: Of same basic metal and alloy as fastened metal or 300 Series stainless steel, unless otherwise indicated. Do not use metals that are incompatible with joined materials.

D. Postinstalled Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed, for masonry, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.3 FABRICATION, GENERAL

A. Assemble louvers in factory to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.

C. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

D. Include supports, anchorages, and accessories required for complete assembly. Provide custom stainless steel anchoring clips compatible with clips at Cooling Tower; provide mating clips.

E. Provide vertical mullions of type and at spacings indicated, but not more than recommended by manufacturer, or 72 inches o.c., whichever is less.

1. Fully Recessed Mullions: Provide mullions fully recessed, concealed behind louver blades as indicated on the Drawings. Where length of louver exceeds fabrication and handling limitations, fabricate with close-fitting blade splices designed to permit expansion and contraction. Exposed mullions to be flush with face of blades.

F. Join frame members to each other and to fixed louver blades with fillet welds concealed from view, unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.4 FIXED, EXTRUDED-ALUMINUM LOUVERS

A. Horizontal Storm-Resistant Louvers:

1. Louver Depth: 4 inches.
2. Frame and Blade Nominal Thickness: As required to comply with structural performance requirements, but not less than 0.060 for blades and 0.080 inch for frames.
3. Performance Requirements:

a. Free Area: 45-50%.
b. Wind-Driven Rain Performance: Class A. Not less than 99 percent effectiveness when subjected to a rain fall rate of 3 inches per hour and a wind speed of 29 mph at a core area intake velocity of 98.43 fpm.

4. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

B. High-Performance Organic-Coating Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Fluoropolymer 2-Coat Coating System: Manufacturer's pearlescent mica flake 2-coat, thermocured system consisting of specially formulated inhibitive primer, fluoropolymer color coat, with color coat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 2605.
a. Color and Gloss: Match Valspar Fluoropon Classic II, Champagne Gold, Pearlescent/Mica Fleck Finish.

2.5 LOUVER SCREENS

A. General: Provide screen at each exterior louver.

1. Screen Location for Fixed Louvers: Interior face.
2. Screening Type: Bird screening..

B. Secure screens to louver frames with stainless-steel machine screws, spaced a maximum of 6 inches from each corner and at 12 inches o.c.

C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.

D. Louver Screening for Aluminum Louvers:

1. Bird Screening: Aluminum, 1/2-inch-square mesh, 0.063-inch wire.

2.6 BLANK-OFF PANELS

A. Insulated, Blank-off Panels: Laminated metal-faced panels consisting of insulating core surfaced on back and front with metal sheets.

1. Thickness: 1 inch.
2. Metal Facing Sheets: Aluminum sheet, not less than 0.032-inch nominal thickness.
3. Insulating Core: Rigid insulation board.
4. Seal perimeter joints between panel faces and louver frames with 1/8-by-l-inch PVC compression gaskets.
5. Panel Finish: Same finish applied to louvers.

2.7 FLASHING PANS

A. Provide as specified in Section 076200 - SHEET METAL FLASHING AND TRIM.

2.8 REMOVABLE ACCESS PANEL

A. Louvered panel with concealed frame as indicated on the Drawings. Removable from exterior side.

B. Match adjacent louvers for spacing and face.

C. Coordinate clip mounting with Cooling Tower, provide mating clips.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3 INSTALLATION

A. Locate and place louvers and vents level, plumb, and at indicated alignment with adjacent work.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

C. Form closely fitted joints with exposed connections accurately located and secured.

D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

E. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

F. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.

G. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 07 92 00 - JOINT SEALANTS for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

A. Clean exposed surfaces of louvers and vents that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate until final cleaning.

B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.

C. Restore louvers and vents damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.

1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION 08 90 00

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Interior gypsum wallboard.
2. Tile backing panels.
3. Acoustic insulation in gypsum wallboard assemblies.
4. Non-load-bearing steel framing.
5. Installation of access panels.
6. Marking and identification for fire- and smoke-partitions.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 05 40 00 - COLD-FORMED METAL FRAMING for load-bearing steel framing.
2. Section 06 10 00 - ROUGH CARPENTRY for fire-retardant-treated blocking in exterior walls.
3. Section 06 16 00 - SHEATHING for gypsum sheathing at exterior assemblies.
4. Section 08 31 10 - ACCESS DOORS AND FRAMES for installation in gypsum board assemblies.
5. Section 09 21 20 - GYPSUM BOARD SHAFT WALL ASSEMBLIES for framing, gypsum panels, other components of shaft wall assemblies, and finishing gypsum board shaft wall assemblies.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide fire stop tracks capable of withstanding deflection within limits and under conditions indicated.

1. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure.

B. Marking and Identification for Fire- and Smoke-Partitions: Fire walls, fire barriers, fire partitions, smoke barriers, smoke partitions and other walls required to have protected openings or

penetrations shall be effectively and permanently identified with signs or stenciling. Such identification shall:

1. Be located in accessible concealed floor, floor-ceiling or attic spaces; and
2. Be repeated at intervals not exceeding 30 feet measured horizontally along the wall or partition; and
3. Include lettering not less than 0.5 inch in height, incorporating the suggested wording: "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," or other wording.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.
3. Product Data for Credit IEQ 4.1: For adhesives used to laminate gypsum board panels to substrates, documentation including printed statement of VOC content.

C. Samples: Full-size Sample in 12-inch-long length for each trim accessory indicated.

1.5 QUALITY ASSURANCE

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

C. Drywall Recycling: All new paper-faced gypsum wallboard scrap (cuts from construction but not demolition waste) shall be recycled by Gypsum Recycling America LLC or approved equal.

D. Mockups: Before beginning gypsum board installation, install mockups of at least 100 sq. ft. in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Install mockups for the following:

a. Each level of gypsum board finish indicated for use in exposed locations.
b. Each texture finish indicated.

2. Apply or install final decoration indicated, including painting and wallcoverings, on exposed surfaces for review of mockups.

3. Simulate finished lighting conditions for review of mockups.
4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other causes. Stack panels flat to prevent sagging.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

B. Do not install interior products until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 NON-LOAD-BEARING STEEL FRAMING, GENERAL

A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal, unless otherwise indicated.
2. Protective Coating: manufacturer's standard corrosion-resistant zinc coating, unless otherwise indicated.

2.2 SUSPENSION SYSTEM COMPONENTS

A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch-diameter wire, or double strand of 0.0475-inch-diameter wire.

B. Hanger Attachments to Concrete:

1. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching wire hangers and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E 488 by an independent testing agency.

a. Type: Postinstalled, expansion anchor.

C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.162-inch diameter.

D. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.0538 inch and minimum 1/2-inch- wide flanges with depth as required for span and loading and indicated on Drawings.

E. Furring Channels (Furring Members): 0.0538-inch bare-steel thickness, with minimum 1/2-inch-wide flanges, 3/4 inch deep.

F. Grid Suspension System for Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Armstrong World Industries, Inc.; Drywall Grid Systems.
b. Chicago Metallic Corporation; Drywall Furring System.
c. USG Corporation; Drywall Suspension System.

2.3 STEEL FRAMING FOR FRAMED ASSEMBLIES

A. Steel Studs and Runners: ASTM C 645.

1. Minimum Base-Metal Thickness: 0.0312 inch.

B. Slip-Type Head Joints: Where indicated, provide one of the following:

1. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch- deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging located within 12 inches of the top of studs to provide lateral bracing.
2. Double-Runner System: ASTM C 645 top runners, inside runner with 2-inch-deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.
3. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.

a. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1) Steel Network Inc. (The); VertiClip Series.
2) Superior Metal Trim; Superior Flex Track System (SFT).

C. Fire Stop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness compatible with studs and in width to accommodate depth of studs.

1. Grace Construction Products; FlameSafe FlowTrak System.
2. Fire Trak Corp.; Fire Trak attached to studs with Fire Trak Slip Clip.
3. Metal-Lite, Inc.; The System.

D. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

1. Minimum Base-Metal Thickness: 0.0312 inch.

E. Cold-Rolled Channel Bridging: 0.0538-inch bare-steel thickness, with minimum 1/2-inch- wide flanges.

1. Depth: 1-1/2 inches.
2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch-thick, galvanized steel.

F. Hat-Shaped, Rigid Furring Channels: ASTM C 645.

1. Minimum Base Metal Thickness: 0.0312 inch..
2. Depth: 1-1/2 inches..

G. Resilient Furring Channels: 1/2-inch-deep, steel sheet members designed to reduce sound transmission.

1. Configuration: Asymmetrical or hat shaped.

H. Resilient Sound Isolation Clips: Provide galvanized steel and resilient material sound-isolation clips, equal to the following:

1. Kinetics Noise Control Co.; IsoMax.
2. PAC International, Inc.; RSIC-1.
3. Pliteq, Inc.; GenieClip.

I. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches wall attachment flange of 7/8 inch, minimum bare-metal thickness of 0.0179 inch, and depth required to fit insulation thickness indicated.

J. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

K. Isolation Strip at Exterior Walls: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

2.4 INTERIOR GYPSUM BOARD

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. USG Corporation.
2. Georgia-Pacific (G-P) Gypsum LLC.
3. National Gypsum Company.

B. Gypsum Wallboard: ASTM C 1396.

1. Thickness: 1/2 inch.
2. Long Edges: Tapered.

C. Fire-Resistant Type X: ASTM C 1396.

1. Thickness: 5/8 inch.

2. Long Edges: Tapered.

D. Flexible Type: ASTM C 1396. Manufactured to bend to fit radii and to be more flexible than standard regular-type gypsum board of same thickness.

1. Thickness: 1/4 inch.
2. Long Edges: Tapered.

E. Ceiling Type: Manufactured to have more sag resistance than regular-type gypsum board.

1. Thickness: 1/2 inch.
2. Long Edges: Tapered.

F. Abuse-Resistant Type: ASTM C 1629. Manufactured to produce greater resistance to surface indentation and through-penetration (impact resistance) than standard, regular-type and Type X gypsum board.

1. Core: 5/8 inch, Type X.
2. Long Edges: Tapered.

G. Moisture- and Mold-Resistant Gypsum Board: ASTM C 1396. With moisture- and mold-resistant core and paper surfaces.

1. Core: 5/8 inch, Type X.
2. Long Edges: Tapered.
3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.5 TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A118.9 and ASTM C 1288 or 1325, with manufacturer's standard edges.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Custom Building Products; Wonderboard.
b. FinPan, Inc.; Util-A-Crete Concrete Backer Board.
c. National Gypsum Company; Permabase Cement Board.
d. USG Corporation; DUROCK Cement Board.

2. Thickness: 5/8 inch.
3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.6 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
2. Shapes:

a. Cornerbead.
b. Bullnose bead.

c. LC-Bead: J-shaped; exposed long flange receives joint compound.
d. Expansion (control) joint.
e. Curved-Edge Cornerbead: With notched or flexible flanges.

B. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Fry Reglet Corp.
b. Gordon, Inc.
c. Pittcon Industries.

2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221, Alloy 6063-T5.
3. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.

2.7 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:

1. Interior Gypsum Wallboard: Paper.
2. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
3. Fill Coat: For second coat, use setting-type, sandable topping compound.
4. Finish Coat: For third coat, use setting-type, sandable topping compound.
5. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound.

D. Joint Compound for Tile Backing Panels:

1. Cementitious Backer Units: As recommended by backer unit manufacturer.
2. Water-Resistant Gypsum Backing Board: Use setting-type taping compound and setting-type, sandable topping compound.

2.8 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

1. Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

D. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

E. Acoustical Sealant: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1. Use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Acoustical Sealant for Exposed and Concealed Joints:

a. Pecora Corp.; AC-20 FTR Acoustical and Insulation Sealant.
b. USG Corporation.; SHEETROCK Acoustical Sealant.

3. Acoustical Sealant for Concealed Joints:

a. Ohio Sealants, Inc.; Pro-Series SC-170 Rubber Base Sound Sealant.
b. Pecora Corp.; BA-98.
c. Tremco, Inc.; Tremco Acoustical Sealant.

2.9 IDENTIFICATION LABELS FOR FIRE- AND SMOKE-PARTITIONS

A. Identification Labels: Vinyl adhesive signs, to comply with applicable local Code.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Fire Wall Signs, Inc.
b. Safety Supply Warehouse.

2. Text: "FIRE AND SMOKE BARRIER - PROTECT ALL OPENINGS"

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames and framing, for compliance with requirements and other conditions affecting performance.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

B. Coordination with Sprayed Fire-Resistive Materials:

1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling runners (tracks) to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches o.c.
2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of non-load-bearing steel framing. Do not reduce thickness of fire-resistive materials below that required for fire-resistance ratings indicated. Protect adjacent fire-resistive materials from damage.

3.3 INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754. Also comply with requirements in ASTM C 840 that apply to framing installation.

B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

C. Install bracing at terminations in assemblies.

D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING SUSPENSION SYSTEMS

A. Install suspension system components in sizes and spacings indicated on Drawings, but not less than those required by referenced installation standards for assembly types and other assembly components indicated.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.

a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.

a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.

3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
5. Do not attach hangers to steel roof deck.
6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
8. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

E. Seismic Bracing: Sway-brace suspension systems with hangers used for support..

F. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

G. Installation Tolerances: Install suspension systems that are level to within [1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

3.5 INSTALLING FRAMED ASSEMBLIES

A. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

B. Install studs so flanges within framing system point in same direction.

C. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.

2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on doorframes; install runner track section (for cripple studs) at head and secure to jamb studs.

    a. Install two studs at each jamb, unless otherwise indicated.
    b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
    c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.

3. Other Framed Openings: Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.

    a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.

5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
6. Curved Partitions:

    a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
    b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of not less than 2 studs at ends of arcs, place studs 6 inches o.c.

D. Direct Furring: Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.

E. Z-Furring Members:

1. Erect insulation vertically and hold in place with Z-furring members spaced 24 inches o.c.
2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches from corner and cut insulation to fit.

3.6 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
2. Fit gypsum panels around ducts, pipes, and conduits.
3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- wide spaces at these locations, and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

3.7 APPLYING INTERIOR GYPSUM BOARD

A. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing, unless otherwise indicated.
2. On partitions/walls, apply gypsum panels to minimize end joints.
3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

B. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints 1 framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
3. On Z-furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.

4. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

C. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.

D. Curved Surfaces:

1. Install panels horizontally (perpendicular to supports) and unbroken, to extent possible, across curved surface plus 12-inch-long straight sections at ends of curves and tangent to them.
2. For double-layer construction, fasten base layer to studs with screws 16 inches o.c. Center gypsum board face layer over joints in base layer, and fasten to studs with screws spaced 12 inches o.c.

3.8 APPLYING TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A108.1, at locations indicated to receive tile, with joints treated to comply with ANSI A108.11.

B. Water-Resistant Backing Board: Install at areas not subject to wetting and elsewhere as indicated with 1/4-inch gap where panels abut other construction or penetrations.

C. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.9 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.

C. Interior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners, unless otherwise indicated.
2. LC-Bead: Use at exposed panel edges.
3. Curved-Edge Cornerbead: Use at curved openings.

D. Aluminum Trim: Install in locations indicated on Drawings.

3.10 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints, rounded or beveled edges, and damaged surface areas.

C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below:

1. Level 1: Ceiling plenum areas and concealed areas not exposed to view.
2. Level 2: Panels that are substrate for tile.
3. Level 4: Panel surfaces that will be exposed to view (typical panels).
4. Level 5: Where indicated on Drawings.

E. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.11 INSTALLING IDENTIFICATION FOR FIRE- AND SMOKE-PARTITIONS

A. Marking and Identification for Fire- and Smoke-Partitions: Permanently install as required by Code.

3.12 PROTECTION

A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

B. Remove and replace panels that are wet, moisture damaged, or exhibit mold growth. Repair of damaged panels in place is not acceptable.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 09 21 10

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Gypsum board shaft wall assemblies.
2. Marking and identification for fire- and smoke-partitions.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 08 31 10 - ACCESS DOORS AND FRAMES
2. Section 09 21 10 - GYPSUM BOARD ASSEMBLIES for non-shaft-wall gypsum board assemblies.
3. Section 09 21 10 - GYPSUM BOARD ASSEMBLIES for applying and finishing panels in gypsum board shaft wall assemblies.

1.3 DEFINITIONS

A. Gypsum Board Construction Terminology: Refer to ASTM C 11 for definitions of terms for gypsum board construction not defined in this Section or in other referenced standards.

1.4 PERFORMANCE REQUIREMENTS

A. Structural Performance:

1. Provide gypsum board shaft wall assemblies capable of withstanding the full air-pressure loads indicated for maximum heights of partitions without failing and while maintaining an airtight and smoke-tight seal. Evidence of failure includes deflections exceeding limits indicated, bending stresses causing studs to break or to distort, and end-reaction shear causing track (runners) to bend or to shear and studs to become crippled.
2. Provide gypsum board shaft wall assemblies for horizontal duct enclosures capable of spanning distances indicated within deflection limits indicated.

B. Marking and Identification for Fire- and Smoke-Partitions: Fire walls, fire barriers, fire partitions, smoke barriers, smoke partitions and other walls required to have protected openings or

penetrations shall be effectively and permanently identified with signs or stenciling. Such identification shall:

1. Be located in accessible concealed floor, floor-ceiling or attic spaces; and
2. Be repeated at intervals not exceeding 30 feet measured horizontally along the wall or partition; and
3. Include lettering not less than 0.5 inch in height, incorporating the suggested wording: "FIRE AND/OR SMOKE BARRIER-PROTECT ALL OPENINGS," or other wording.

1.5 SUBMITTALS

A. Product Data: For each gypsum board shaft wall assembly indicated.

B. LEED Submittals:

1. Credit IEQ 4.1: Manufacturers' product data for adhesives used to laminate gypsum board panels to substrates and acoustical sealants, including printed statement of VOC content.

C. Fire-Test-Response Reports: From a qualified independent testing and inspecting agency substantiating each gypsum board shaft wall assembly's required fire-resistance rating.

1. Include data substantiating that elevator entrances and other items that penetrate each gypsum board shaft wall assembly do not negate fire-resistance rating.

1.6 QUALITY ASSURANCE

A. Fire-Resistance-Rated Assemblies: Provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

1. Fire-Resistance-Rated Assemblies: Indicated by design designations from FM's "Approval Guide, Building Products," UL's "Fire Resistance Directory," or ITS's "Directory of Listed Products."

B. STC-Rated Assemblies: For gypsum board shaft wall assemblies indicated to have STC ratings, provide assembly materials and construction complying with requirements of assemblies whose STC ratings were determined according to ASTM E 90 and classified according to ASTM E 413 by a qualified independent testing agency.

C. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 01. Review methods and procedures for installing work related to gypsum board shaft wall assemblies including, but not limited to, the following:

1. Fasteners proposed for anchoring steel framing to building structure.
2. Sprayed fire-resistive materials applied to structural framing.
3. Elevator equipment, including hoistway doors, elevator call buttons, and elevator floor indicators.
4. Wiring devices in shaft wall assemblies.
5. Doors and other items penetrating shaft wall assemblies.
6. Items supported by shaft wall-assembly framing.
7. Mechanical work enclosed within shaft wall assemblies.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages, containers, and bundles bearing brand name and identification of manufacturer or supplier.

B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Stack gypsum panels flat on leveled supports off the ground to prevent sagging.

1.8 PROJECT CONDITIONS

A. Comply with requirements for environmental conditions, room temperatures, and ventilation specified in Section 09 21 10 - GYPSUM BOARD ASSEMBLIES.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. American Gypsum Co.
2. G-P Gypsum Corp.
3. National Gypsum Company.
4. United States Gypsum Co.

2.2 ASSEMBLY MATERIALS

A. General: Provide materials and components complying with requirements of fire-resistance-rated assemblies indicated.

1. Provide panels in maximum lengths available to eliminate or minimize end-to-end butt joints.
2. Provide auxiliary materials complying with gypsum board shaft wall assembly manufacturer's written recommendations.

B. Steel Framing: ASTM C 645.

1. Protective Coating: ASTM A 653/A 653M, G40, hot-dip galvanized coating.

C. Gypsum Liner Panels: Manufacturer's proprietary liner panels in 1-inch thickness and with moisture-resistant paper faces.

D. Gypsum Wallboard: ASTM C 1396, core type as required by fire-resistance-rated assembly indicated.

E. Accessories: Cornerbead, edge trim, and control joints of material and shapes specified in Section 09 21 10 - GYPSUM BOARD ASSEMBLIES comply with gypsum board shaft wall assembly manufacturer's written recommendations for application indicated.

F. Gypsum Wallboard Joint-Treatment Materials: ASTM C 475 and as specified in Section 09 21 10 - GYPSUM BOARD ASSEMBLIES.

G. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

H. Track (Runner) Fasteners: Power-driven fasteners of size and material required to withstand loading conditions imposed on shaft wall assemblies without exceeding allowable design stress of track, fasteners, or structural substrates in which anchors are embedded.

1. Powder-Actuated Fasteners: Provide powder-actuated fasteners with capability to sustain, without failure, a load equal to 10 times that imposed by shaft wall assemblies, as determined by testing conducted by a qualified independent testing agency according to ASTM E 1190.
2. Postinstalled Expansion Anchors: Where indicated, provide expansion anchors with capability to sustain, without failure, a load equal to 5 times that imposed by shaft wall assemblies, as determined by testing conducted by a qualified independent testing agency according to ASTM E 488.

I. Laminating Adhesive: Adhesive or joint compound recommended by manufacturer for directly adhering gypsum face-layer panels and gypsum-base face-layer panels to backing-layer panels in multilayer construction.

1. Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

J. Acoustical Sealant: As recommended by gypsum board shaft wall assembly manufacturer for application indicated.

1. Use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

K. Sound Attenuation Blankets: ASTM C 665 for Type I, unfaced mineral-fiber-blanket insulation produced by combining thermosetting resins with mineral fibers manufactured from slag or rock wool.

2.3 GYPSUM BOARD SHAFT WALL

A. Basis-of-Design Product: As indicated on Drawings by design designation of a qualified testing and inspecting agency.

B. Sustained Air-Pressure Loads: 5 lbf/sq. ft.

C. Deflection Limit: L/240.

D. Studs: Manufacturer's standard profile for repetitive members and corner and end members and for fire-resistance-rated assembly indicated.

1. Depth: As indicated.
2. Minimum Base Metal Thickness: Manufacturer's standard thicknesses that comply with structural performance requirements for stud depth indicated.

E. Track (Runner): Manufacturer's standard J-profile track with long-leg length as standard with manufacturer, but at least 2 inches in depth matching studs.

1. Minimum Base Metal Thickness: Manufacturer's standard thicknesses that comply with structural performance requirements for stud depth indicated.

F. Jamb Struts: Manufacturer's standard J-profile strut with long-leg length of 3 inches, in depth matching studs, and not less than 0.0341 inch thick.

G. Room-Side and Shaft-Side Finish: As indicated.

H. STC Rating: As indicated.

I. Cavity Insulation: Sound attenuation blankets.

2.4 IDENTIFICATION LABELS FOR FIRE- AND SMOKE-PARTITIONS

A. Identification Labels: Vinyl adhesive signs, to comply with applicable local Code.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Fire Wall Signs, Inc.
b. Safety Supply Warehouse.

2. Text: "FIRE AND SMOKE BARRIER-PROTECT ALL OPENINGS"

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates to which gypsum board shaft wall assemblies attach or abut, with Installer present, including hollow-metal frames, elevator hoistway doorframes, cast-in anchors, and structural framing. Examine for compliance with requirements for installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Sprayed Fire-Resistive Materials: Coordinate with gypsum shaft wall assemblies so both elements of Work remain complete and undamaged. Patch or replace sprayed fire-resistive materials removed or damaged during installation of shaft wall assemblies to comply with requirements specified in Section 07 81 00 - APPLIED FIREPROOFING.

1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling runners (tracks) to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches o.c.
2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of gypsum board assemblies and without reducing the fire-resistive

material thickness below that which is required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

3.3 INSTALLATION

A. General: Install gypsum board shaft wall assemblies to comply with requirements of fire-resistance-rated assemblies indicated, manufacturer's written installation instructions, and the following:

1. ASTM C 754 for installing steel framing and gypsum shaft wallboard.

B. Do not bridge building expansion joints with shaft wall assemblies; frame both sides of joints with furring and other support.

C. Install supplementary framing in gypsum board shaft wall assemblies around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment, services, heavy trim, furnishings, and similar items that cannot be supported directly by shaft wall assembly framing.

1. At elevator hoistway doorframes, provide jamb struts on each side of doorframe.
2. Where handrails directly attach to gypsum board shaft wall assemblies, provide galvanized steel reinforcing strip with 0.0312-inch minimum thickness of base (uncoated) metal, accurately positioned and secured behind at least 1 face-layer panel.

D. Integrate stair hanger rods with gypsum board shaft wall assemblies by locating cavity of assemblies where required to enclose rods.

E. At penetrations in shaft wall, maintain fire-resistance rating of shaft wall assembly by installing supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, elevator call buttons, elevator floor indicators, and similar items.

F. Isolate gypsum finish panels from building structure to prevent cracking of finish panels while maintaining continuity of fire-rated construction.

G. Install control joints to maintain fire-resistance rating of assemblies.

H. Seal gypsum board shaft walls with acoustical sealant at perimeter of each assembly where it abuts other work and at joints and penetrations within each assembly. Install acoustical sealant to withstand dislocation by air-pressure differential between shaft and external spaces; maintain an airtight and smoke-tight seal; and comply with manufacturer's written instructions or ASTM C 919, whichever is more stringent.

I. In elevator shafts where gypsum board shaft wall assemblies cannot be positioned within 2 inches of the shaft face of structural beams, floor edges, and similar projections into shaft, install 1/2- or 5/8-inch- thick, gypsum board cants covering tops of projections.

1. Slope cant panels at least 75 degrees from horizontal. Set base edge of panels in adhesive and secure top edges to shaft walls at 24 inches o.c. with screws fastened to shaft wall framing.

2. Where steel framing is required to support gypsum board cants, install framing at 24 inches o.c. and extend studs from the projection to the shaft wall framing.

3.4 FINISHING GYPSUM BOARD SHAFT WALL ASSEMBLIES

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints, rounded or beveled edges, and damaged surface areas.

C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below:

1. Level 1: Ceiling plenum areas and concealed areas not exposed to view.
2. Level 2: Panels that are substrate for tile.
3. Level 4: Panel surfaces that will be exposed to view (typical panels).
4. Level 5: Where indicated on Drawings.

3.5 INSTALLING IDENTIFICATION FOR FIRE- AND SMOKE-PARTITIONS

A. Marking and Identification for Fire- and Smoke-Partitions: Permanently install as required by Code.

3.6 PROTECTION

A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

B. Remove and replace panels that are wet, moisture damaged, or exhibit mold growth. Repair of damaged panels in place is not acceptable.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 09 21 20

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Floor tile.
2. Wall tile.
3. Ceiling tile.
4. Exterior tile at water feature.
5. Exterior tile at soffits.
6. Stone thresholds installed as part of tile installations.
7. Waterproofing and crack-suppression membrane for thin-set tile installations.
8. Elastomeric sealants for expansion, contraction, control, and isolation joints in tile surfaces.
9. Surface preparation for tile and accessories.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 03 30 00 - CAST-IN-PLACE CONCRETE for monolithic slab finishes specified for tile substrates.
2. Section 07 92 00 - JOINT SEALANTS for sealing of joints between dissimilar materials.
3. Section 08 31 10 - ACCESS DOORS AND FRAMES for installation in tile.
4. Section 09 21 10 - GYPSUM BOARD ASSEMBLIES for cementitious backer units.
5. Section 09 63 40 - STONE FLOORING for stone stair treads.

1.3 PERFORMANCE REQUIREMENTS

A. Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ASTM C 1028:

1. Level Surfaces: Minimum 0.6.
2. Step Treads: Minimum 0.6.
3. Ramp Surfaces: Minimum 0.8.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. LEED Submittals:

1. Credit IEQ 4.1: Manufacturers' product data for adhesives and sealants, including printed statement of VOC content.
2. Credit IEQ 4.3: Manufacturers' product data for tile floors, documentation from an independent testing agency indicating compliance with the FloorScore Standard.
3. Credit IEQ 4.3: Manufacturers' product data for tile setting adhesives, including printed statement of VOC content.

C. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.

D. Samples for Verification:

1. Assembled samples with grouted joints for each type and composition of tile and for each color and finish required, at least 12 inches square and mounted on rigid panel. Use grout of type and in color or colors approved for completed work.
2. Full-size units of each type of trim and accessory for each color and finish required.
3. Stone thresholds in 6-inch lengths.
4. Metal edge strips in 6-inch lengths.

E. Qualification Data: For Installer.

F. Material Test Reports: For each tile-setting and -grouting product.

1.5 QUALITY ASSURANCE

A. Source Limitations for Tile: Obtain all tile of same type and color or finish from one source or producer.

1. Obtain tile from same production run and of consistent quality in appearance and physical properties for each contiguous area.

B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from a single manufacturer and each aggregate from one source or producer.

C. Source Limitations for Other Products: Obtain each of the following products specified in this Section through one source from a single manufacturer for each product:

1. Stone thresholds.
2. Waterproofing.
3. Joint sealants.
4. Metal edge strips.

D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirement in ANSI A137.1 for labeling sealed tile packages.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Store liquid additives in unopened containers and protected from freezing.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. American Olean.
2. Buchtal USA.
3. Crossville, Inc.
4. Daltile; Division of Dal-Tile International Inc.
5. Flor Gres Ceramiche.
6. Moving Color.

B. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1, "Specifications for Ceramic Tile," for types, compositions, and other characteristics indicated.

1. Provide tile complying with Standard grade requirements, unless otherwise indicated.
2. For facial dimensions of tile, comply with requirements relating to tile sizes specified in Part 1 "Definitions" Article.
3. Provide tiles as indicated on the Finish Schedule and as approved by the Architect.

C. Porcelain Paver Tile – Basis-of-Design: Castanea, Luserno - CT10 by Daltile. Color body porcelain, 10.5 in by 15. 5 in.

D. Floor Tile – Basis-of-Design: Provide custom pattern as indicated on the Drawings.

1. CT-1 / Floor Tile #1: American Olean, 2 in. by 2 in. Porcelain Mosaic, Dill Pickle, A83.
2. CT-2 / Floor Tile #2: American Olean, 2 in. by 2 in. Porcelain Mosaic, Vanilla Cream, A95.
3. CT-3 / Floor Tile #3: American Olean, 2 in. by 2 in. Porcelain Mosaic, Mushroom, A38.
4. CT-4 / Floor Tile #4: American Olean, 2 in. by 2 in. Porcelain Mosaic, French Roast, A15.

E. Ceiling Tile – Basis-of-Design:

1. CT-5 / Ceramic Tile #5: American Olean, 2 in. by 2 in. Ceramic Mosaic, color Light Blue.
2. CT-6 / Ceramic Tile #6: American Olean, 2 in. by 2 in. Ceramic Mosaic, color Medium Blue.
3. CT-7 / Ceramic Tile #7: American Olean, 2 in. by 2 in. Ceramic Mosaic, color Dark Blue.

F. Wall Tile – Basis-of-Design:

1. CT-1 / Floor Tile #1: American Olean, 2 in. by 2 in. Porcelain Mosaic, Dill Pickle, A83.
2. CT-2 / Floor Tile #2: American Olean, 2 in. by 2 in. Porcelain Mosaic, Vanilla Cream, A95.
3. CT-3 / Floor Tile #3: American Olean, 2 in. by 2 in. Porcelain Mosaic, Mushroom, A38.
4. CT-4 / Floor Tile #4: American Olean, 2 in. by 2 in. Porcelain Mosaic, French Roast, A15.
5. CT - ACCENT TILE: American Olean, 1 in. by 1 in. ACCENT TILE, color Red.
6. CT-8 / Ceramic Tile #8: Heat Reactive Ceramic Tile, Moving Color, Watercolors - 4 in. by 4 in., color Magenta.
7. CT-9 / Ceramic Tile #9: Heat Reactive Ceramic Tile, Moving Color, Watercolors - 4 in. by 4 in., color Blue
8. CT-10 / Ceramic Tile #10: Heat Reactive Ceramic Tile, Moving Color, Watercolors - 4 in. by 4 in., color Orange.

G. Base Wall Tile – Basis-of-Design:

1. CT-5 / Ceramic Tile #5: American Olean, 2 in. by 2 in. Porcelain Mosaic, color Medium Blue.
2. CT-6 / Ceramic Tile #6: American Olean, 2 in. by 2 in. Porcelain Mosaic, color Dark Blue.
3. CT-7 / Ceramic Tile #7: American Olean, 2 in. by 2 in. Porcelain Mosaic, color Cobalt Blue.

H. Exterior Tile at Water Feature – Basis-of-Design:

1. Unglazed Ceramic Mosaic Tile: American Olean Colorbody Porcelain Mosaic.

2. Provide range of up to 5 colors. Colors and patterns as selected by the Architect.

I. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI standards referenced in "Setting and Grouting Materials" Article.

J. Factory Blending: For tile exhibiting color variations within ranges selected during Sample submittals, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

K. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer, unless otherwise indicated.

L. Tile Trim Units: Matching characteristics of adjoining flat tile and coordinated with sizes and coursing of adjoining flat tile where applicable. Provide shapes selected from manufacturer's standard shapes.

M. Metal Edge Strips: Angle or L-shape, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications; extruded aluminum exposed-edge material, with clear anodized satin finish.

1. Available Manufacturer: Schluter Systems.

N. TH-1/Stone Threshold #1 – Marble Thresholds: Uniform, fine- to medium-grained white stone with gray veining, ASTM C 503 with a minimum abrasion resistance of 10 per ASTM C 1353 or ASTM C 241 and with honed finish. Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.

1. Bevel edges at 1:2 slope, aligning lower edge of bevel with adjacent floor finish. Limit height of bevel to 1/2 inch or less, and finish bevel to match face of threshold.

O. Fabric-Reinforced, Fluid-Applied Waterproofing and Crack Suppression Membrane: System consisting of liquid-latex rubber, with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), and fabric reinforcement.

1. Custom Building Products; 9240 Waterproofing and Anti-Fracture Membrane.
2. LATICRETE International Inc.; Laticrete 9235 Waterproof Membrane.
3. MAPEI Corporation; PRP M19.
4. Summitville Tiles, Inc.; S-9000.

P. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

Q. Latex-Portland Cement Mortar (Thin Set): ANSI A118.4.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Bonsal American; an Oldcastle company.
   b. Bostik, Inc.
   c. Laticrete International, Inc.
   d. MAPEI Corporation.
   e. Summitville Tiles, Inc.
   f. TEC; a subsidiary of H. B. Fuller Company.

2. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
3. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.
   a. For glass tile wall applications, provide white color mortar.

R. Polymer-Modified Tile Grout: ANSI A118.7.

1. Polymer Type: Acrylic resin or styrene-butadiene rubber in liquid-latex form for addition to prepackaged dry-grout mix.

   a. Unsanded grout mixture for joints 1/8 inch and narrower.

b. Sanded grout mixture for joints 1/8 inch and wider.

S. Joint Grout, Epoxy Type: Provide chemical resistant, water cleanable, tile grouting epoxy, conforming to ANSI A118.3, as follows:

1. Available Product: Laticrete SpectraLock Pro Grout.
2. Colors: A selection of at least fourteen standard colors plus black, white, and natural must be available for Architect's selection.

T. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

U. Grout Sealer: Manufacturer's standard silicone product for sealing grout joints that does not change color or appearance of grout.

2.2 ELASTOMERIC SEALANTS

A. General: Provide manufacturer's standard chemically curing, elastomeric sealants of base polymer and characteristics indicated. Comply with applicable requirements in Section 07 92 00 - JOINT SEALANTS.

1. Use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints, unless otherwise indicated.

C. One-Part, Mildew-Resistant Silicone Sealant: ASTM C 920; Type S; Grade NS; Class 25; Uses NT, G, A, and, as applicable to nonporous joint substrates indicated, O; formulated with fungicide, intended for sealing interior ceramic tile joints and other nonporous substrates that are subject to in-service exposures of high humidity and extreme temperatures.

1. Available Products:

a. Dow Corning Corporation; Dow Corning 786.
b. GE Silicones; Sanitary 1700.
c. Pecora Corporation; Pecora 898 Sanitary Silicone Sealant.
d. Tremco, Inc.; Tremsil 600 White.

D. Multipart, Pourable Urethane Sealant for Use T: ASTM C 920; Type M; Grade P; Class 25; Uses T, M, A, and, as applicable to joint substrates indicated, O.

1. Available Products:

a. Bostik; Chem-Calk 550.
b. Tremco, Inc.; Vulkem 245.
c. Pecora Corporation; NR-200 Urexpan.
d. Tremco, Inc.; THC-900.

2.3 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

B. Add materials, water, and additives in accurate proportions.

C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.

1. Verify that substrates for setting tile are firm; dry; clean; free of oil, waxy films, and curing compounds; and within flatness tolerances required by referenced ANSI A108 Series of tile installation standards for installations indicated.
2. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed before installing tile.
3. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove coatings, including curing compounds and other substances that contain soap, wax, oil, or silicone, that are incompatible with tile-setting materials.

B. Provide concrete substrates for tile floors that comply with flatness tolerances specified in referenced ANSI A108 Series of tile installation standards.

1. Fill cracks, holes, and depressions with trowelable leveling and patching compound according to tile-setting material manufacturer's written instructions. Use product specifically recommended by tile-setting material manufacturer.
2. Remove protrusions, bumps, and ridges by sanding or grinding.

C. Blending: For tile exhibiting color variations within ranges selected during Sample submittals, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 INSTALLATION, GENERAL

A. ANSI Tile Installation Standards: Comply with parts of ANSI A108 Series "Specifications for Installation of Ceramic Tile" that apply to types of setting and grouting materials and to methods indicated in ceramic tile installation schedules.

B. TCA Installation Guidelines: TCA's "Handbook for Ceramic Tile Installation." Comply with TCA installation methods indicated in ceramic tile installation schedules.

C. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions, unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

D. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

E. Jointing Pattern: Lay tile in grid pattern, unless otherwise indicated. Align joints when adjoining tiles on floor, base, walls, and trim are same size. Lay out tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths, unless otherwise indicated.

1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.

F. Lay out tile wainscots to next full tile beyond dimensions indicated.

G. Expansion Joints: Locate expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.

1. Locate joints in tile surfaces directly above joints in concrete substrates.
2. Prepare joints and apply sealants to comply with requirements in Section 07 92 00 - JOINT SEALANTS.

H. Grout tile to comply with requirements of the following tile installation standards:

1. For ceramic tile grouts (sand-portland cement; dry-set, commercial portland cement; and latex-portland cement grouts), comply with ANSI A108.10.
2. For chemical-resistant epoxy grouts, comply with ANSI A108.6.

I. At showers, tubs, and where indicated, install cementitious backer units and treat joints to comply with ANSI A108.11 and manufacturer's written instructions for type of application indicated.

3.4 WATERPROOFING AND CRACK-SUPPRESSION MEMBRANE INSTALLATION

A. Install waterproofing to comply with ANSI A108.13 and waterproofing manufacturer's written instructions to produce waterproof membrane of uniform thickness bonded securely to substrate.

B. Install crack-suppression membrane to comply with manufacturer's written instructions to produce membrane of uniform thickness bonded securely to substrate.

C. Do not install tile over waterproofing until waterproofing has cured and been tested to determine that it is watertight.

3.5 FLOOR TILE INSTALLATION

A. General: Install tile to comply with requirements in the Floor Tile Installation Schedule, including those referencing TCA installation methods and ANSI A108 Series of tile installation standards.

1. For installations indicated below, follow procedures in ANSI A108 Series tile installation standards for providing 95 percent mortar coverage.

B. Stone Thresholds: Install stone thresholds at locations indicated; set in same type of setting bed as abutting field tile, unless otherwise indicated.

1. Set thresholds in latex-portland cement mortar for locations where mortar bed would otherwise be exposed above adjacent nontile floor finish.

C. Metal Edge Strips: Install at locations indicated or where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile.

3.6 WALL TILE INSTALLATION

A. Install types of tile designated for wall installations to comply with requirements in the Wall Tile Installation Schedule, including those referencing TCA installation methods and ANSI setting-bed standards.

3.7 EXTERIOR CEILING TILE INSTALLATION

A. Install types of tile designated for ceiling installations to comply with requirements in the Exterior Tile Installation Schedule, including those referencing TCA installation methods and ANSI setting-bed standards.

3.8 CLEANING AND PROTECTING

A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

1. Remove grout residue from tile as soon as possible.
2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions, but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
3. Remove temporary protective coating by method recommended by coating manufacturer that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent it from clogging drains.

B. When recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear.

C. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed. After seven days, cover areas subject to construction traffic with heavy cardboard.

D. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

3.9 TILE INSTALLATION SCHEDULE

A. This schedule refers to Tile Installation Types. Refer to Finish Schedule for Tile Product Types.

B. Floor Tile FT-1: Interior floor installation on concrete; thin-set mortar; TCA F113 and ANSI A108.5.

1. Tile Type: Unglazed ceramic mosaic as selected by Architect.
2. Thin-Set Mortar: Latex-portland cement mortar.
3. Grout: Polymer-modified unsanded grout.
4. Joint Width: 1/16 inch.

C. Floor Tile FT-2: Interior floor installation on concrete; thin-set mortar, epoxy grout; TCA F115 and ANSI A108.5.

1. Tile Type: Unglazed paver tile as selected by Architect.
2. Thin-Set Mortar: Latex-portland cement mortar.
3. Grout: Chemical-resistant, water-cleanable, tile-setting and -grouting epoxy.
4. Joint Width: 1/8 inch.

D. Floor Tile FT-3: Interior floor installation on waterproof membrane over concrete; thin-set mortar; TCA F122 and ANSI A108.5.

1. Tile Type: Unglazed ceramic mosaic tile as selected by Architect.
2. Thin-Set Mortar: Latex-portland cement mortar.
3. Grout: Polymer-modified unsanded grout.
4. Joint Width: 1/16 inch.

E. Wall Tile Installation WT-1: Interior wall installation over sound, dimensionally stable masonry or concrete; thin-set mortar; TCA W202 and ANSI A108.5.

1. Tile Type: Glazed ceramic tile as selected by Architect.
2. Thin-Set Mortar: Latex-portland cement mortar.
3. Grout: Polymer-modified unsanded grout.
4. Joint Width: 1/16 inch.

F. Wall Tile Installation WT-2: Interior wall installation over cementitious backer units; thin-set mortar; TCA W244 and ANSI A108.5.

1. Tile Type: Glazed ceramic tile as selected by Architect.
2. Thin-Set Mortar: Latex-portland cement mortar.
3. Grout: Polymer-modified unsanded grout.
4. Joint Width: 1/16 inch.

G. Wall Tile Installation WT-3: Interior wall and shower-receptor installation over cementitious backer units; thin-set mortar; TCA B415, TCA W244, and ANSI A108.5.

1. Tile Type: Glazed ceramic tile as selected by Architect.
2. Thin-Set Mortar: Latex-portland cement mortar.
3. Grout: Polymer-modified unsanded grout.
4. Joint Width: 1/16 inch.

H. Soffit Tile Installation: Exterior soffit installation over cementitious backer units; thin-set, back-buttering required; thin-set mortar; TCA C315 and ANSI A108.5.

1. Tile Type: Glazed ceramic tile as selected by Architect.
2. Thin-Set Mortar: Latex-portland cement mortar.
3. Grout: Polymer-modified unsanded grout.
4. Joint Width: 1/8 inch.

END OF SECTION 09 30 00

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Acoustical ceiling tiles and panels.
2. Metal mesh ceiling panels.
3. Suspension systems, grid systems and ceiling hangers.
4. Acoustical sealant at edge moldings at acoustical ceilings.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 09 21 10 - GYPSUM BOARD ASSEMBLIES for gypsum board ceilings and soffits.
2. Division 21 - FIRE PROTECTION for fire-suppression components located in ceilings.
3. Division 23 - HEATING, VENTILATING AND AIR CONDITIONING for air handling and distribution components located in ceilings.
4. Division 26 - ELECTRICAL for light fixture and alarm system components located in ceilings.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. LEED Submittals:

1. Credit IEQ 4.1, manufacturers' product data for sealants, including printed statement of VOC content.

C. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items. Show the following:

1. Ceiling suspension members.

2. Method of attaching hangers to building structure. Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.
3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
4. Minimum Drawing Scale: 1/4 inch = 1 foot.

D. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.

1. Acoustical Panel: Set of 6 inch square Samples of each type, color, pattern, and texture.
2. Exposed Suspension System Members, Moldings, and Trim: Set of 12 inch long Samples of each type, finish, and color.

E. Asbestos Certification: Manufacturer's written certification that acoustical ceiling products contain no asbestos (0.0000%). Product labels indicating that it is the user's responsibility to test the products for asbestos are unacceptable and sufficient cause for rejection of the product on site.

F. Maintenance Data: For finishes to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Source Limitations:

1. Acoustical Ceiling Panels: Obtain each type through one source from a single manufacturer.
2. Suspension Systems: Obtain each type through one source from a single manufacturer.

B. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:

1. Fire-Resistance Characteristics: Where indicated, provide acoustical panel ceilings identical to those of assemblies tested for fire resistance per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

a. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.
b. Identify materials with appropriate markings of applicable testing and inspecting agency.

2. Surface-Burning Characteristics: Provide acoustical panels complying with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84:

C. Mockups: Build mockups to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution.

1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.7 COORDINATION

A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 ACOUSTICAL PANELS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Armstrong World Industries, Inc.
2. CertainTeed Corp.
3. Chicago Metallic Corporation.
4. USG Interiors, Inc.; Subsidiary of USG Corporation.

B. Ceiling Tile – Basis-of-Design:

1. ACP-1 / Acoustic Ceiling Panel #1: Armstrong, Ultima Healthzone, 24 in. by 24 in., Beveled Tegular.
2. ACP-2 / Acoustic Ceiling Panel #2: Armstrong, Optima Open Plan, 24 in. by 24 in., Square Tegular.
3. ACP-3 / Acoustic Ceiling Panel #3: Armstrong, Ultima Healthzone, 24 in. by 24 in., Beveled Tegular.
4. ACP-4 / Acoustic Ceiling Panel #4: Armstrong, Clean Room VL, 24 in. by 24 in., Lay-In.
5. ACP-5 / Acoustic Ceiling Panel #5: Armstrong, Ultima, 24 in. by 24 in., Beveled Tegular.
6. ACP-6 / Acoustic Ceiling Panel #6: Armstrong, Ultima, 24 in. by 24 in., Beveled Tegular.
7. ACP-7 / Acoustic Ceiling Panel #7: Armstrong, Optima, 24 in. by 24 in., Square Tegular.

C. Metal Mesh Ceiling Panels – Basis-of-Design:

1. MTL-1 / Metal Mesh Panels: Metal Works, Mesh Woven Wire Twin Round Narrow by Armstrong.

2.2 SUSPENSION SYSTEMS

A. Metal Suspension System for ACP-1. ACP-2, ACP-5, ACP-6, and ACP-7: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.

1. Manufacturer: USG, Armstrong, Celotex or Chicago Metallic.
2. Structural Classification: Heavy-duty system.
3. End Condition of Cross Runners: Override (stepped) or butt-edge type.
4. Face Design: Flat, flush.
5. Cap Material: Steel or aluminum cold-rolled sheet.
6. Color: White, prefinished; color grid at ACP-5 as selected by the Architect.
7. Grid Face Width: As specified with ACP type.

B. Fiberglass Suspension System for ACP-3 and ACP-4: High-strength pultruded FRP ceiling grid system equal to Kemlite Sanigrid II, KEELGRID by KEEL MFG Inc., or GridLock by Life Science Products, Inc. Grid shall be moisture resistant, not support mold or mildew and not rust or corrode; meeting USDA/FSIS requirements.

1. Fire-Rating: Class A Flame spread of less than 25, smoke developed less than 450 per ASTM E-84 latest version.
2. Structural Classification: Heavy-duty system.
3. End Condition of Cross Runners: Override (stepped) or butt-edge type.
4. Face Design: Flat, flush.
5. Color: White.
6. Grid Face Width: As specified with ACP type.

C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated.

1. Anchors in Concrete: Anchors with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing per ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency; zinc-plated for Class SC1 service.

2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated, and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing per ASTM E 1190, conducted by a qualified testing and inspecting agency.

3. Provide stainless steel anchors at fiberglass grid system.

D. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:

1. Zinc-Coated Carbon-Steel Wire at Metal Grid: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
2. Stainless-Steel Wire at Fiberglass Grid: ASTM A 580/A 580M, Type 304, nonmagnetic.

3. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106 diameter wire.

E. Hold-Down Clips: At vestibules and areas subject to wind uplift, provide manufacturer's standard hold-down clips spaced 24 inches on all cross tees.

2.3 METAL EDGE MOLDINGS AND TRIM

A. Roll-Formed Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that fit acoustical panel edge details and suspension systems indicated; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.

1. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.
2. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.
3. For narrow-face suspension systems, provide suspension system and manufacturer's standard edge moldings that match width and configuration of exposed runners.

B. Suspension Trim: Subject to compliance with requirements, provide one of the following:

1. Armstrong World Industries, Inc.; Axiom.
2. BPB USA; Approved equal.
3. USG Interiors, Inc.; Compasso

2.4 ACOUSTICAL SEALANT

A. Acoustical Sealant for Concealed Joints: Manufacturer's standard nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant, with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), recommended for sealing interior concealed joints to reduce airborne sound transmission.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

A. General: Install acoustical panel ceilings to comply with ASTM C 636 per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
5. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
6. Do not attach hangers to steel deck tabs.
7. Space hangers not more than 48 o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.

C. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

D. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

E. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.

1. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
2. Install hold-down clips in areas indicated, in areas required by authorities having jurisdiction, and for fire-resistance ratings; space as recommended by panel manufacturer's written instructions, unless otherwise indicated.

3.4 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 09 51 00

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Stone treads at Knuckle Lobby interior monumental stair.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 10, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 05 51 00 - METAL STAIRS AND RAILINGS for stair fabrication.
2. Section 07 92 00 - JOINT SEALANTS for sealing control and expansion joints in stone treads with elastomeric sealants.

1.3 SUBMITTALS

A. Product Data: For the following:

1. Each variety of stone. Include data on physical properties required by referenced ASTM standards.
2. Stone accessories and other manufactured products.

B. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.
2. Product Data for Credit IEQ 4.3: For adhesives and grout, documentation including printed statement of VOC content.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other Work.

D. Samples for Verification:

1. For each stone type indicated, in sets of Samples not less than 12 inches square. Include two or more Samples in each set and show the full range of variations in appearance characteristics expected in completed Work.

E. Qualification Data: For Installer.

F. Maintenance Data: For stone treads to include in maintenance manuals. Include Product Data for stone-care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An installer who employs experienced mechanics and stone fitters who are skilled in installing stone treads similar in material, design, and extent to those indicated for this Project and whose projects have a record of successful in-service performance.

B. Fabricator Qualifications: Shop that employs skilled workers who fabricate stone treads similar to those indicated for this Project and whose products have a record of successful in-service performance.

C. Source Limitations for Stone: Obtain each variety of stone, regardless of finish, from a single quarry with resources to provide materials of consistent quality in appearance and physical properties.

1. Obtain each variety of stone from a single quarry, whether specified in this Section or in another Section of the Specifications.

D. Source Limitations for Other Materials: Obtain each type of cementitious material, grout, admixture, stone accessory, sealant, and other material from a single manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Lift stone with wide-belt slings; do not use wire rope or ropes that might cause staining. Move stone, if required, using dollies with cushioned wood supports.

B. Store stone on pallets with nonstaining separators and nonstaining, waterproof covers. Ventilate under covers to prevent condensation.

C. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

1.6 PROJECT CONDITIONS

A. Do not set stone when air or material temperature is below 50 deg F.

B. Maintain minimum ambient temperatures of 50 deg F during installation and for 7 days after completion unless higher temperatures are required by fabricator's or supplier's instructions.

PART 2 - PRODUCTS

2.1 STONE, GENERAL

A. Varieties and Sources: Subject to compliance with requirements, provide one of the stone varieties specified for each stone type in Part 2 "Stone Types" Article.

B. Match Architect's samples for variety, color, finish, and other stone characteristics relating to aesthetic effects.

C. Provide stone that is free of cracks, seams, and starts impairing structural integrity or function.

D. Provide stone from a single quarry for each variety of stone required.

E. Quarry stone in a manner to ensure that as-quarried block orientations yield finished stone with required characteristics.

F. Make stone slabs available for Architect to examine for appearance characteristics.

1. Architect will select aesthetically acceptable slabs and will indicate aesthetically unacceptable slabs and portions of slabs.
2. Segregate slabs selected for use on Project and mark backs indicating approval.
3. Mark and photograph aesthetically unacceptable portions of slabs as directed by Architect.

2.2 STONE TYPES

A. Granite: Provide granite complying with ASTM C 615 and NBGQA's "Specifications for Architectural Granite" and as follows:

B. Stone Tile at Stair Treads – Basis-of-Design: Granite, Verde Tropical to match Architect's sample. It is the design intent to match the approved porcelain floor tile in the Knuckle Lobby for color and overall appearance.

C. Finish - Top and Edges: Flamed/Brushed

D. Edge Detail: Beveled nosing; see architectural details.

E. Size and Configuration: As indicated on the Drawings.

F. Match Architect's sample for color, finish, grain, veining, and other stone characteristics relating to aesthetic effects.

2.3 ACCESSORIES

A. Water-Cleanable Epoxy Adhesive: ANSI A118.3.

1. Adhesive shall have a VOC content of not more than 100 g/L when calculated according to South Coast District (SCAQMD) Rule #1168.

B. Abrasive Inserts for Stair Treads: Abrasive strips consisting of aluminum oxide, silicon carbide, or a combination of both, in an epoxy-resin binder, fabricated for installing in routed grooves of stair treads to provide slip resistance. Provide epoxy-resin installation adhesive compatible with inserts.

C. Cleaner: Stone cleaner specifically formulated for stone types, finishes, and applications indicated, as recommended by stone producer and, if a sealer is specified, by sealer manufacturer. Do not use cleaning compounds containing acids, caustics, harsh fillers, or abrasives.

D. Floor Sealer: Colorless, slip- and stain-resistant sealer that does not affect color or physical properties of stone surfaces, as recommended by stone producer for application indicated.

1. Floor coatings shall have a VOC content of not more than 100 g/L when calculated according to South Coast District (SCAQMD) Rule #1113, Architectural Coatings, rules in effect January 1, 2004.

2.4 STONE FABRICATION

A. General: Fabricate stone treads in sizes and shapes necessary to comply with requirements indicated, including details on Drawings and Shop Drawings.

1. For granite, comply with recommendations in NBGQA's "Specifications for Architectural Granite."

B. Cut stone to produce pieces of thickness, size, and shape indicated and to comply with fabrication and construction tolerances recommended by applicable stone association.

1. Pattern: As indicated on the Drawings.
2. Stone Edges: Square.
3. Cut stone to produce uniform joints, 1/16 wide, in locations indicated.
4. Clean sawed backs of stones to remove rust stains and iron particles.

C. Pattern Arrangement: Fabricate and arrange stone units with veining and other natural markings to comply with the following requirements:

1. Cut stone from one block or contiguous, matched blocks in which natural markings occur.
2. Arrange units with veining as indicated on Drawings.

D. Fabricate stone stair treads in sizes and profiles indicated. Rout grooves into treads to receive abrasive strips and install strips to comply with manufacturer's written instructions.

E. Carefully inspect finished stone units at fabrication plant for compliance with requirements for appearance, material, and fabrication. Replace defective units.

1. Grade and mark stone for overall uniform appearance when assembled in place. Natural variations in appearance are acceptable if installed stone units match range of colors and other appearance characteristics represented in approved samples and mockups.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces indicated to receive stone treads, with Installer present, for compliance with requirements for maximum moisture content, installation tolerances, and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Vacuum clean concrete substrates to remove dirt, dust, debris, and loose particles.

B. Remove substances from concrete substrates that could impair mortar bond, including curing and sealing compounds, form oil, and laitance.

C. Clean dirty or stained stone surfaces by removing soil, stains, and foreign materials before setting. Clean stone by thoroughly scrubbing with fiber brushes and then drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh materials or abrasives.

3.3 INSTALLATION, GENERAL

A. Do necessary field cutting as stone is set. Use power saws with diamond blades to cut stone. Cut lines straight and true, with edges eased slightly to prevent snipping.

B. Set stone to comply with Drawings and Shop Drawings.

C. Scribe and field-cut stone as necessary to fit at obstructions. Produce tight and neat joints.

3.4 INSTALLATION TOLERANCES

A. Variation in Line: For positions shown in plan for edges of paving, flooring, ramps, steps, changes in color or finish, and continuous joint lines, do not exceed 1/8 inch in 96 inches, 1/4 inch in 20 feet or 3/8 inch maximum.

B. Variation in Joint Width: Do not vary joint thickness more than 1/16 inch or 1/4 of nominal joint width, whichever is less.

C. Variation in Surface Plane of Treads: Do not exceed 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 3/8 inch maximum from level or slope indicated.

D. Variation in Plane between Adjacent Units (Lipping): Do not exceed 1/32-inch difference between planes of adjacent units.

3.5 STONE STAIR TREAD INSTALLATION

A. Install stone stair treads to comply with "Installation of Stone Directly over Concrete" Article.

B. Install stone stair treads in a full bed of water-cleanable epoxy adhesive to comply with ANSI A108.4.

3.6 ADJUSTING AND CLEANING

A. Remove and replace stone treads of the following description:

1. Broken, chipped, stained, or otherwise damaged stone. Stone may be repaired if methods and results are approved by Architect.
2. Defective joints.
3. Stone treads and joints not matching approved samples and mockups.
4. Stone treads not complying with other requirements indicated.

B. Replace in a manner that results in stone treads matching approved samples and mockups, complying with other requirements, and showing no evidence of replacement.

C. In-Progress Cleaning: Clean stone treads as work progresses. Remove mortar fins and smears before tooling joints.

D. Clean stone treads after setting and grouting are complete. Use procedures recommended by stone fabricator for types of application.

E. Apply sealer to cleaned stone treads according to sealer manufacturer's written instructions.

3.7 PROTECTION

A. Prohibit traffic from installed stone for a minimum of 72 hours.

B. Protect stone treads during construction with nonstaining kraft paper. Where adjoining areas require construction work access, cover stone treads with a minimum of 3/4-inch untreated plywood over nonstaining kraft paper.

END OF SECTION 09 63 40

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Vinyl tile floor covering.
2. Rubber sheet floor covering.
3. Resilient wall base and accessories.
4. Resilient stair accessories.
5. Substrate preparation for resilient flooring and accessories.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 09 68 10 - TILE CARPETING for carpet accessories.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For adhesives and glues used at Project site, documentation including printed statement of VOC content.
2. Product Data for Credit IEQ 4.3: For interior flooring used at Project site, documentation including printed statement of VOC content and compliance with FloorScore Standard.

C. Shop Drawings: For each type of floor covering. Include floor covering layouts, locations of seams, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.

1. Show details of special patterns.

D. Samples for Verification: Full-size units of each color and pattern of resilient floor tile required.

1. Resilient Wall Base and Accessories: Manufacturer's standard-size Samples, but not less than 12 inches long, of each resilient product color and pattern required.

E. Manufacturer's Representative Testing Review: Submit certification and approval of moisture testing and testing results.

F. Maintenance Data: For resilient products to include in maintenance manuals.

G. Maintenance Material Submittals: Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Floor Tile: Furnish 3% of each type, color, and pattern of flooring installed.

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Provide products identical to those tested for fire-exposure behavior per test method indicated by a testing and inspecting agency acceptable to authorities having jurisdiction.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store tiles on flat surfaces.

1.6 PROJECT CONDITIONS

A. Maintain temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F in spaces to receive floor tile during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. After postinstallation period, maintain temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

C. Close spaces to traffic during floor covering installation.

D. Close spaces to traffic for 48 hours after floor covering installation.

E. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 VINYL ENHANCED TILE FLOOR COVERING

A. Vinyl Tile Floor Covering: ASTM F 1066.

1. Altro Group.
2. Armstrong World Industries, Inc.
3. Mannington Mills, Inc.
4. Roppe

5. Tarkett, Inc.
6. TOLI International.

B. Style and Colors - Basis-of-Design: Colors as selected by the Architect from manufacturer's standard colors. Installation pattern to be determined by the Architect using equal amounts of each color.

1. R-1 / Resilient Tile Flooring #1: Johnsonite, Color Essence, color #1 and color #2.
2. R-2 / Resilient Tile Flooring #2: NOT USED.
3. R-3 / Resilient Tile Flooring #3: NOT USED.
4. R-4 / Resilient Tile Flooring #4: Johnsonite, Color Essence, color #3 and color #4.

C. Thickness: 0.080 inch.

D. Size: 12 in. by 12 in.

E. Wearing Surface: Smooth.

F. Static Load Limit: Minimum 400 psi.

G. Seaming Method: Standard.

H. Warranty: 10 years.

2.2 RUBBER SHEET FLOOR COVERING

A. Unbacked Rubber Sheet Floor Covering: ASTM F 1859, Type I (homogeneous rubber sheet).

1. Estrie Products International, American Biltrite (Canada) Ltd.
2. Flexco.
3. Johnsonite.
4. Mondo Rubber International, Inc.
5. Nora Rubber Flooring, Freudenberg Building Systems, Inc.
6. R.C.A. Rubber Company (The).

B. Style and Colors - Basis-of-Design:

1. RF-1 / Rubber Flooring - Rubber #1: Mannington, Colorscape - Premium Rubber Tile, color Forest #915.

C. Thickness: As standard with manufacturer.

D. Wearing Surface: Molded pattern.

1. Molded-Pattern Figure: Raised discs.

E. Sheet Width: As standard with manufacturer.

F. Seaming Method: Standard.

2.3 RESILIENT WALL BASE

A. Wall Base: ASTM F 1861.

1. Armstrong World Industries, Inc.
2. Azrock Commercial Flooring, DOMCO
3. Burke Mercer Flooring Products
4. Johnsonite
5. Marley Flexco (USA), Inc.
6. Nora Rubber Flooring, Freudenberg Building Systems, Inc.
7. Roppe Corporation

B. Style and Colors - Basis-of-Design:

1. RB-1 / Rubber Wall Base #1: Johnsonite, Match paint color P-1.
2. RB-2 / Rubber Wall Base #2: Johnsonite, Match paint color P-2.
3. RB-3 / Rubber Wall Base #3: Johnsonite, Match paint color P-3.
4. RB-4 / Rubber Wall Base #4: Johnsonite, Match paint color P-4.

C. Type (Material Requirement): TS (rubber, vulcanized thermoset) or TP (rubber, thermoplastic).

D. Shape: Straight (toeless) at carpet and coved at resilient flooring.

E. Minimum Thickness: 0.125 inch.

F. Height: 6 inches.

G. Lengths: Cut lengths 48 inches long or coils in manufacturer's standard length.

H. Outside Corners: Premolded.

I. Inside Corners: Premolded.

J. Surface: Smooth.

2.4 RESILIENT STAIR ACCESSORIES

A. Treads and Risers: FS RR-T-650.

1. Burke Mercer Flooring Products
2. Endura
3. Johnsonite
4. Mondo Rubber International, Inc.
5. Nora Rubber Flooring, Freudenberg Building Systems, Inc.
6. Roppe Corporation

B. Style and Colors - Basis-of-Design:

1. RF-1 / Rubber Flooring - Rubber #1: Mannington, Colorscape - Premium Rubber Tile, color Forest #915.

C. Material: Rubber, Composition A.

D. Size: Lengths and depths to fit each stair tread in one piece.

E. Stringers: Of same thickness as risers, height and length after cutting to fit risers and treads and to cover stair stringers; produced by same manufacturer as treads and recommended by manufacturer for installation with treads.

2.5 RESILIENT MOLDING ACCESSORY

A. Types Include the Following as Applicable: Cap for cove carpet, cap for cove resilient sheet floor covering, carpet edge for glue-down applications, nosing for carpet, nosing for resilient floor covering, reducer strip for resilient floor covering, joiner for tile and carpet

1. Burke Mercer Flooring Products
2. Johnsonite
3. Marley Flexco (USA), Inc
4. Roppe Corporation

B. Material: Rubber.

C. Profile and Dimensions: As indicated.

2.6 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, Portland cement based or blended hydraulic cement based formulation provided or approved by resilient product manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

a. VCT and Asphalt Tile Adhesives: 50 g/L.
b. Cove Base Adhesives: 50 g/L.
c. Rubber Floor Adhesives: 60 g/L.

C. Stair-Tread-Nose Filler: Two-part epoxy compound recommended by resilient tread manufacturer to fill nosing substrates that do not conform to tread contours.

D. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of tiles, and in maximum available lengths to minimize running joints.

E. Floor Polish: Provide protective liquid floor polish products as recommended by manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written recommendations to ensure adhesion of resilient products.

B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
3. Moisture Testing: Flooring manufacturer’s representative to witness testing and approve testing and substrate in writing.

a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
b. Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.

C. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.

D. Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates.

E. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

1. Do not install resilient products until they are same temperature as space where they are to be installed.

F. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 SHEET INSTALLATION

A. Comply with manufacturer's written instructions for installing floor coverings.

B. Unroll floor coverings and allow them to stabilize before cutting and fitting.

C. Lay out floor coverings as follows:

1. Maintain uniformity of floor covering direction.
2. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least 6 inches away from parallel joints in floor covering substrates.

3. Match edges of floor coverings for color shading at seams.
4. Avoid cross seams.

D. Scribe and cut floor coverings to butt neatly and tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, and door frames.

E. Extend floor coverings into toe spaces, door reveals, closets, and similar openings.

F. Maintain reference markers, holes, or openings that are in place or marked for future cutting by repeating on floor coverings as marked on substrates. Use chalk or other nonpermanent marking device.

G. Install floor coverings on covers for telephone and electrical ducts and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of floor coverings installed on covers and adjoining floor covering. Tightly adhere floor covering edges to substrates that abut covers and to cover perimeters.

H. Adhere floor coverings to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 TILE INSTALLATION

A. Lay out tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

1. Lay tiles in pattern indicated.

B. Match tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

C. Scribe, cut, and fit tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, edgings, doorframes, thresholds, and nosings.

D. Extend tiles into toe spaces, door reveals, closets, and similar openings.

E. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.

F. Install tiles on covers for telephone and electrical ducts and similar items in finished floor areas. Maintain overall continuity of color and pattern with pieces of tile installed on covers. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.

G. Adhere tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.5 RESILIENT WALL BASE INSTALLATION

A. Apply wall base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

B. Install wall base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.

C. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

D. Do not stretch wall base during installation.

E. On masonry surfaces or other similar irregular substrates, fill voids along top edge of wall base with manufacturer's recommended adhesive filler material.

F. Premolded Corners: Install premolded corners before installing straight pieces.

3.6 RESILIENT ACCESSORY INSTALLATION

A. Resilient Stair Accessories:

1. Use stair-tread-nose filler to fill nosing substrates that do not conform to tread contours.
2. Tightly adhere to substrates throughout length of each piece.
3. For treads installed as separate, equal-length units, install to produce a flush joint between units.

B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor coverings that would otherwise be exposed.

3.7 CLEANING AND PROTECTION

A. Perform the following operations immediately after completing resilient product installation:

1. Remove adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

a. Do not wash surfaces until after time period recommended by manufacturer.

B. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.

1. Apply protective floor polish to horizontal surfaces that are free from soil, visible adhesive, and surface blemishes if recommended in writing by manufacturer.

a. Coordinate selection of floor polish with the Owner’s maintenance service.

2. Cover products installed on horizontal surfaces with undyed, untreated building paper until Substantial Completion.

3. Do not move heavy and sharp objects directly over surfaces. Place hardboard or plywood panels over flooring and under objects while they are being moved. Slide or roll objects over panels without moving panels.

END OF SECTION 09 65 10

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Resinous flooring systems.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 07 92 00 - JOINT SEALANTS for sealants installed at joints in resinous flooring systems.

1.3 PERFORMANCE REQUIREMENTS

A. Chemical Resistance:

1. Request from the Owner detailed information for these agents including concentration utilized and frequency of application for each.
2. Certify in writing to the Owner and Architect that resinous flooring systems can resist repeated exposure to these agents.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include manufacturer's technical data, application instructions, and recommendations for each resinous flooring component required.

B. LEED Submittals:

1. Product Data for Credit IEQ 4.2: For liquid-applied flooring components, documentation including printed statement of VOC content.

C. Shop Drawings: Provide floor plans, to scale matching Architectural Plans, which indicate extent of each different resinous flooring system including system type, color and pattern, degree of slip resistance, and dimensioned locations of control joints and seams where systems meet.

1. Provide enlarged details, at minimum 3 inch = 1 foot scale, indicating conditions at walls, door frames, pits, curbs, equipment pedestals, etc.

D. Samples for Verification: For each resinous flooring system required, 6 inches square, applied to a rigid backing by Installer for this Project.

E. Material Certificates: For each resinous flooring component, signed by manufacturer.

F. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.

G. Manufacturer's Representative Testing Review: Submit certification and approval of moisture testing and testing results.

H. Maintenance Data: For resinous flooring to include in maintenance manuals.

I. Test Results: For field testing of substrate, signed by installer.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer (applicator) who is experienced in applying resinous flooring systems similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance, and who is acceptable to resinous flooring manufacturer.

1. Engage an installer who employs only persons trained and approved by resinous flooring manufacturer for applying resinous flooring systems indicated.
2. Engage an installer who is certified in writing by resinous flooring manufacturer as qualified to apply resinous flooring systems indicated.

B. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, through one source from a single manufacturer. Provide secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from source recommended by manufacturer of primary materials.

C. Mockups: Apply mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Apply full-thickness mockups on 48-inch- square floor area selected by Design Professional.

   a. Include 48-inch length of integral cove base.

2. Simulate finished lighting conditions for Design Professional's review of mockups.
3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

D. Pre-installation Conference: Prior to installation of flooring, meet at the Project site with the Manufacturer's Representative, the Installer, the Architect, the Owner's Representative and the Owner's Testing Agency. Record discussions and furnish copy to each participant. Topics to be discussed shall include, but not be limited to:

1. Existing and new slab conditions
2. Owner's Testing Agency results of mandatory testing
3. Surface preparation
4. Required room temperatures
5. Ventilation
6. Step-by-step application procedures
7. Curing time and methods
8. Protection of completed Work

E. Testing:

1. ASTM E 1907 Standard Guide to Methods of Evaluating Moisture Conditions of Concrete Floors to Receive Resilient Floor Coverings
   a. ASTM F 1869 Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Sub-floor Using Anhydrous Calcium Chloride
   b. ASTM D 4263 Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method
   c. ASTM F 2170 Standard Test Method for Determining Relative Humidity in Concrete Slabs Using in situ Probes
2. ASTM F 710 Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring
3. ASTM D 4501 Standard Test Method for Shear Strength of Adhesive Bonds Between Rigid Substrates by the Block-Shear Method

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.

B. Store materials to prevent deterioration from moisture, heat, cold, direct sunlight, or other detrimental effects.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.

1. Maintain ambient air temperature between 65oF and 85oF.
2. Type I Concrete substrate shall be properly cured for a minimum of 30 days. Type III Concrete shall be properly cured for a minimum of 7 days.

B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.

C. Close spaces to traffic during resinous flooring application and for not less than 24 hours after application, unless manufacturer recommends a longer period.

1.8 WARRANTY

A. Manufacturer shall furnish a single, written warranty covering 100% of the material and labor costs protecting the client from delamination, disbondment, and osmotic/hydrostatic failure for a period of three (3) years from date of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1. Crossfield Products Corp.
2. Key Resin.
3. Stonhard, Inc.
4. Tnemec Company Inc.

B. VOC Content of Liquid-Applied Flooring Components: Mot more than 100 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

2.2 RESINOUS FLOORING SYSTEM

A. Troweled epoxy mortar with clear epoxy receiving coat, decorative quartz broadcast and clear epoxy sealer coat:

1. Basis-of Design Product: “Stonshield HRI” by Stonhard, Inc.

B. System Characteristics:

1. Color: Equal to Cypress by Stonhard.
2. Wearing Surface: Textured for slip resistance.
3. Integral Cove Base: 4 inches high with 1 inch radius.
4. Overall System Thickness: 3/16 inch (not including osmotic pressure barrier or grout).
5. VOC: Less than 100 g/l.

C. System Components: Manufacturer's standard components which are compatible with each other and as follows:

1. Osmotic Pressure Barrier (if required): Three-component, polymer modified, cementitious grout for use under resinous flooring systems to be applied on concrete slabs on grade.
   a. Basis-of Design Product: “Stonfil OP2” by Stonhard, Inc.
   b. Thickness: 1/8 inch minimum, no thin film systems will be accepted.
   c. Primer: “Stonfil OP2 Primer” by Stonhard, Inc.
2. Primer: Type recommended by manufacturer for substrate and body coat(s) indicated.
3. (option) Grout: 3-component, epoxy chemistry, compatible with flooring system, screeded and troweled to provide specified slope to drains
4. Troweled Mortar (no slurry systems accepted):
   a. Resin: 100 % solids epoxy
   b. Application Method: Steel troweled, hand or power trowel

c. Aggregate: Silica
d. Thickness: minimum 1/8 in.

5. Receiving Coat:
   a. Resin: 100 % solids epoxy
   b. Color: Clear
6. Broadcast:
   a. Aggregate: Ceramic coated quartz
   b. Color: selected from manufacturer's full range
7. Seal Coat(s):
   a. Resin: 100% solids epoxy
   b. Color: Clear
   c. Number of Seal Coats: 2 for smoother than medium texture

2.3 ACCESSORY MATERIALS

A. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated.

PART 3 - EXECUTION

3.1 PREPARATION

A. General: Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry, and neutral Ph substrate for resinous flooring application.

B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.

1. Roughen concrete substrates as follows:
   a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
   b. Comply with ASTM C 811 requirements, unless manufacturer's written instructions are more stringent.
2. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written recommendations.
3. Verify that concrete substrates are dry.
   a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with application only after substrates have maximum moisture-vapor-emission rate as required by the manufacturer.
   b. Perform plastic sheet test, ASTM D 4263. Proceed with application only after testing indicates absence of moisture in substrates.
   c. Perform additional moisture tests recommended by manufacturer. Proceed with application only after substrates pass testing.
4. Verify that concrete substrates have neutral pH and that resinous flooring will adhere to them. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.

C. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.

D. Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.

E. Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written recommendations.

3.2 APPLICATION

A. General: Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.

1. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
2. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.
3. At substrate expansion and isolation joints, provide joint in resinous flooring to comply with resinous flooring manufacturer's written recommendations.
   a. Apply joint sealant to comply with manufacturer's written recommendations.

B. Apply primer over prepared substrate at manufacturer's recommended spreading rate.

C. Apply waterproofing membrane, where indicated, in manufacturer's recommended thickness.

1. Apply waterproofing membrane to integral cove base substrates.

D. Apply reinforcing membrane to substrate cracks.

E. Integral Cove Base: Apply cove base mix to wall surfaces before applying flooring. Apply according to manufacturer's written instructions and details including those for taping, mixing, priming, troweling, sanding, and topcoating of cove base. Round internal and external corners.

F. Apply self-leveling slurry body coat(s) in thickness indicated for flooring system.

1. Broadcast aggregates and, after resin is cured, remove excess aggregates to provide surface texture indicated.

G. Apply troweled or screeded body coat(s) in thickness indicated for flooring system. Hand or power trowel and grout to fill voids. When cured, sand to remove trowel marks and roughness.

H. Apply grout coat, of type recommended by resinous flooring manufacturer to fill voids in surface of final body coat and to produce wearing surface indicated.

I. Apply topcoat(s) in number of coats indicated for flooring system and at spreading rates recommended in writing by manufacturer.

J. Apply chemical resistant coat(s) in number of coats indicated for flooring system and at spreading rates recommended in writing by manufacturer.

K. Apply UV resistant topcoat(s) in number of coats indicated for flooring system and at spreading rates recommended in writing by manufacturer.

L. Apply slip resistant texture approved by Architect.

3.3 FIELD QUALITY CONTROL

A. Testing and Monitoring Equipment Calibrations: Owner's Testing Agency shall test and demonstrate to the Engineer/Architect, Installer and Owner's Representative that calibrations on all testing and monitoring equipment are providing accurate readings.

B. Manufacturer's Field Service: Manufacturer will send qualified technical representative to the Project site for the following purposes:

1. Coordinate schedule, environmental requirements, and pre-installation work with other trades.
2. Advise Installer's personnel of procedures and precautions for use of flooring materials.
3. Attend moisture testing and all other testing procedures with the Engineer/Architect, the Owner's Representative and the Installer in attendance.
4. Submit certification of approval of moisture testing and results in writing.
5. Observe field mock-ups with the Engineer/Architect, the Owner's Representative and the Installer in attendance.
6. Make periodic site visits and include record of observations by manufacturer's technical representative in the applicators project documentation log.
7. Ascertain that each component of flooring system is being installed in accordance with manufacturer's instructions.
8. Maintain a log of environmental conditions, work procedures, testing procedures, and protection measures to be included in job site file submittal.

C. Testing of Floor Slabs:

1. Before installation of flooring, test floor slabs for containment of moisture and moisture vapor emission, pH, and alkalinity levels that would be detrimental to adhesion of resinous flooring materials.
2. Complete the following moisture tests as described below and as documented in ASTM E 1907.
   a. Testing of floor slabs for containment of moisture and moisture vapor emission shall be by calcium chloride test method in accordance with ASTM F 1869.
      1) For slabs on grade one test kit shall be placed for every 1000.sq. ft. of concrete slab area
      2) For elevated slabs one test kit shall be placed for every 5000 sq. ft. of concrete slab area
      3) Maximum transmission emission level for slabs on grade shall be 3 lbs of water per every 1000 sq ft. of floor slab area in 24 hour period.
      4) Maximum transmission emission level for elevated slabs shall be 3 lbs. of water per 5000 sq. ft. of floor slab area in 24 hour period.
      5) Protect against rewetting of concrete after testing.
      6) Coordinate environmental controls in advance and continuing for duration of flooring installation.
   b. Perform plastic sheet tests per ASTM D 4263.
   c. Perform relative humidity tests using probes per ASTM F 2170.
3. Perform pH tests per ASTM F 710.

4. Perform additional moisture tests recommended by manufacturer with Owner's approval.
5. Verify that concrete substrates have neutral ph and that resinous flooring will adhere to them. It is mandatory that installer proceed with application only after substrates successfully pass testing listed above.

3.4 CLEANING AND PROTECTING

A. Protect resinous flooring from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by resinous flooring manufacturer.

END OF SECTION 09 67 10

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Modular carpet tile.
2. Carpet accessories.
3. Substrate preparation for carpet and accessories.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 09 65 10 - RESILIENT FLOORING AND ACCESSORIES for resilient wall base and accessories installed with carpet.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include manufacturer's written data on physical characteristics, durability, and fade resistance. Include installation recommendations for each type of substrate.

B. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For adhesives and glues used at Project site, documentation including printed statement of VOC content.
2. Product Data for Credit IEQ 4.3: For interior flooring used at Project site, documentation including printed statement of VOC content and compliance with the Carpet and Rug Institute’s Green Label Plus program.

C. Shop Drawings: Show the following:

1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
2. Carpet tile type, color, and dye lot.
3. Type of subfloor.
4. Type of installation.

5. Pattern of installation.
6. Pattern type, location, and direction.
7. Pile direction.
8. Type, color, and location of insets and borders.
9. Type, color, and location of edge, transition, and other accessory strips.
10. Transition details to other flooring materials.

D. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

1. Carpet Tile: Full-size Sample.
2. Exposed Edge, Transition, and other Accessory Stripping: 12-inch-long Samples.

E. Product Schedule: For carpet tile. Use same designations indicated on Drawings.

F. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:

1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

G. Maintenance Material Submittals: Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is certified by the Floor Covering Installation Board or who can demonstrate compliance with its certification program requirements.

B. Fire-Test-Response Characteristics: Provide products with the critical radiant flux classification indicated in Part 2, as determined by testing identical products per ASTM E 648 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

C. Mockups: Before installing carpet tile, build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Approved mockups may become part of the completed Work if undamaged at time of Substantial Completion.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Comply with CRI 104, Section 5, "Storage and Handling."

1.6 PROJECT CONDITIONS

A. Comply with CRI 104, Section 7.2, "Site Conditions; Temperature and Humidity" and Section 7.12, "Ventilation."

B. Environmental Limitations: Do not install carpet tiles until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.

D. Where equipment or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.7 WARRANTY

A. Special Carpet Warranty: Written warranty, signed by carpet manufacturer agreeing to replace carpet that does not comply with requirements or that fails within specified warranty period. Warranty does not include deterioration or failure of carpet due to unusual traffic, failure of substrate, vandalism, or abuse. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, and delamination.

1. Warranty Period: Ten years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CARPET TILE

A. Products: Subject to compliance with requirements, provide one of the following:

1. C-1 / Carpet #1: Mannington, Spatial Progressions 1, Formation- 4206.
2. C-2 / Carpet #2: Mannington, Sylvan Structures, Architecture - 4302.
3. C-3 / Carpet # 3: Mannington, Spatial Progressions 1, Pastoral - 3404.

B. Tiles: 26 oz polypropylene backing.

C. LEED Requirement: Carpets installed in the building interior shall meet the testing and product requirements of the Carpet and Rug Institutes Green Label Plus Program.

2.2 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.

B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and is recommended by carpet tile manufacturer for releasable installation.

1. VOC Limits: Provide adhesives with VOC content not more than 50g/L when calculated according to 40 CFR 59, Subpart D (EPA method 24).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Examine carpet tile for type, color, pattern, and potential defects.

B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:

1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet tile manufacturer.
2. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Comply with CRI 104, Section 7.3, "Site Conditions; Floor Preparation," and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates.

C. Broom and vacuum clean substrates to be covered immediately before installing carpet. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

A. General: Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.

B. Installation Method: Partial glue down; install periodic tiles with releasable, pressure-sensitive adhesive.

C. Maintain dye lot integrity. Do not mix dye lots in same area.

D. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.

E. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.

G. Install pattern parallel to walls and borders.

3.4 CLEANING AND PROTECTION

A. Perform the following operations immediately after installing carpet tile:

1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
2. Remove yarns that protrude from carpet tile surface.
3. Vacuum carpet tile using commercial machine with face-beater element.

B. Protect installed carpet tile to comply with CRI 104, Section 16, "Protection of Indoor Installations."

C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 09 68 10

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Vinyl wall covering with custom imagery at Knuckle Lobby lower level wall frieze.

2. Vinyl wall covering with custom imagery at multi-story atrium wall.

3. Acrylic wall covering with custom imagery at the underside of the Knuckle Lobby bridge.

B. Owner-Furnished Materials:

C. Related Sections:

1. Division 09 Section Interior Painting for priming wall surfaces.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include data on physical characteristics, durability, fade resistance, and flame-resistance characteristics.

B. LEED Submittals:

1. "Product Data for Credit IEQ 4.1" Subparagraph below applies to LEED-NC, LEED-CI, and LEED-CS; coordinate with requirements selected in Part 2 for adhesives.
2. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.
3. Product Data for Credit IEQ 4.2: For paints and coatings, documentation including printed statement of VOC content.
4. Laboratory Test Reports for Credit IEQ 4: For wall covering systems, adhesives, and, paints and coatings, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Shop Drawings: Show location and extent of each wall-covering type. Indicate pattern placement seams and termination points.

D. Samples for Initial Selection: For each type of wall covering indicated.

E. Samples for Verification: Full width by 36-inch (914-mm-) long section of wall covering.

1. Sample from same print run or dye lot to be used for the Work, with specified treatments applied. Mark top and face of fabric.

2. Submit "mini-mural" of complete finished image printed on actual substrate specified.

3. Submit sample section of final image at 100% resolution printed on actual substrate specified.

F. Product Schedule: For wall coverings.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for wall covering.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For wall coverings to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Wall-Covering Materials: For each type, full-size units equal to 5 percent of amount installed.

1.7 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: As determined by testing identical wall coverings applied with identical adhesives to substrates according to test method indicated below by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Surface-Burning Characteristics: As follows, per ASTM E 84 class B:

a. Flame-Spread Index: 26-75.
b. Smoke-Developed Index: 450 or less.

2. Fire-Growth Contribution: Textile wall coverings complying with acceptance criteria of Class A per ASTM E84 OR1.
3. Fire-Growth Contribution: Textile wall coverings tested according to NFPA 265 and complying with test protocol and criteria in the CSBC.

B. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockups for each type of wall covering on each substrate required. Comply with requirements in ASTM F 1141.

2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install wall coverings until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

B. Lighting: Do not install wall covering until a permanent level of lighting is provided on the surfaces to receive wall covering.

C. Ventilation: Provide continuous ventilation during installation and for not less than the time recommended by wall-covering manufacturer for full drying or curing.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Low-Emitting Materials: Wall covering system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 WALL COVERINGS

A. General: Provide rolls of each type of wall covering from same print run or dye lot.

2.3 VINYL WALL COVERING

A. Vinyl Wall-Covering Standards: Provide mildew-resistant products complying with the following:

1. FS CCC-W-408D and CFFA-W-101-D for Type II, Medium-Duty products.
2. ASTM F 793 for wall coverings that qualify as Category V, Type II, Commercial Serviceability products.
3. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:

   a. DesignTex Ecore Advanced Wall Technology.

B. Total Weight Excluding Coatings:

C. Width: 54 inches.

D. Backing: Nonwoven fabric.

E. Print Technology: UV Curable Inkjet

F. Colors, Textures, and Patterns: As selected by Architect from manufacturer's full range.

2.4 ADHESIVES

A. Adhesives: Mildew-resistant, nonstaining, strippable adhesive, for use with specific wall covering and substrate application; as recommended in writing by wall-covering manufacturer.

1. Adhesive shall have VOC content of [50] <Insert value> g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Primer/Sealer: Mildew resistant, complying with requirements in Division 09 Section "[Interior Painting] <Insert Section title>" and recommended in writing by wall-covering manufacturer for intended substrate.

C. Wall Liner: Nonwoven, synthetic underlayment and adhesive as recommended by wall-covering manufacturer.

D. Seam Tape: As recommended in writing by wall-covering manufacturer.

E. Metal Primer: Interior ferrous metal primer complying with Division 09 Interior Painting

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for levelness, wall plumbness, maximum moisture content, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Comply with manufacturer's written instructions for surface preparation.

B. Clean substrates of substances that could impair bond of wall covering, including dirt, oil, grease, mold, mildew, and incompatible primers.

C. Prepare substrates to achieve a smooth, dry, clean, structurally sound surface free of flaking, unsound coatings, cracks, and defects.

1. Moisture Content: Maximum of 5 percent on new plaster, concrete, and concrete masonry units when tested with an electronic moisture meter.
2. Plaster: Allow new plaster to cure. Neutralize areas of high alkalinity. Prime with primer as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.

3. Metals: If not factory primed, clean and apply metal as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
4. Gypsum Board: Prime with primer as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
5. Painted Surfaces: Treat areas susceptible to pigment bleeding.

D. Check painted surfaces for pigment bleeding. Sand gloss, semigloss, and eggshell finish with fine sandpaper.

E. Remove hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

F. Acclimatize wall-covering materials by removing them from packaging in the installation areas not less than 24 hours before installation.

G. Install wall liner, with no gaps or overlaps, where required by wall-covering manufacturer. Form smooth wrinkle-free surface for finished installation. Do not begin wall-covering installation until wall liner has dried.

3.3 INSTALLATION

A. General: Comply with wall-covering manufacturers' written installation instructions applicable to products and applications indicated except where more stringent requirements apply.

B. Cut wall-covering strips in roll number sequence. Change roll numbers at partition breaks and corners.

C. Install strips in same order as cut from roll.

D. Install reversing every other strip.

E. Install wall covering with no gaps or overlaps, no lifted or curling edges, and no visible shrinkage.

F. Match pattern 72 inches (1830 mm) above the finish floor.

G. Install seams vertical and plumb at least 6 inches (150 mm) from outside corners and 3 inches (75 mm) from inside corners unless a change of pattern or color exists at corner. No horizontal seams are permitted.

H. Fully bond wall covering to substrate. Remove air bubbles, wrinkles, blisters, and other defects.

I. Trim edges and seams for color uniformity, pattern match, and tight closure. Butt seams without any overlay or spacing between strips.

3.4 CLEANING

A. Remove excess adhesive at finished seams, perimeter edges, and adjacent surfaces.

B. Use cleaning methods recommended in writing by wall-covering manufacturer.

C. Replace strips that cannot be cleaned.

D. Reinstall hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

END OF SECTION 097200

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Spray-applied acoustic insulation at Ceiling GWB-3.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 10, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 09 21 10 - GYPSUM BOARD ASSEMBLIES for non-load-bearing steel framing and furring that support insulation; for sound attenuation blankets and acoustical sealants.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Product Data for Credit IEQ 4.1: For adhesives and glues used at Project site, documentation including printed statement of VOC content.
3. Product Data for Credit IEQ 4.2: For interior paints used at Project site, documentation including printed statement of VOC content.

C. Shop Drawings: Show locations, fabrication, and installation of control and expansion joints including plans, elevations, sections, details of components, and attachments to other Work.

D. Samples: For the following products:

1. Textured Finishes: Manufacturer's standard size for each textured finish indicated and on rigid backing.

1.4 QUALITY ASSURANCE

A. Source Limitations for Acoustical Insulation Products: Obtain acoustical insulation products, including joint reinforcing tape, embedding material, and plasters, from a single manufacturer.

B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

C. Finish Mockups: Apply mockups of at least 100 sq. ft. in surface area to demonstrate aesthetic effects and qualities of materials and execution.

1. Apply mockups for the following applications:

a. Walls and Partitions: Smooth and textured finishes.
b. Ceilings: Smooth and textured finishes.

2. Simulate finished lighting conditions for review of mockups.
3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.

B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes.

1. Absorbent Base for Acoustical Plaster: Stack panels flat to prevent sagging.

1.6 PROJECT CONDITIONS

A. Comply with ASTM C 842 requirements or gypsum plaster manufacturer's written recommendations, whichever are more stringent.

B. Room Temperatures: Maintain temperatures at not less than 55 deg F or greater than 80 deg F for at least seven days before application of gypsum plaster, continuously during application, and for seven days after plaster has set or until plaster has dried.

C. Avoid conditions that result in plaster drying too rapidly.

1. Distribute heat evenly; prevent concentrated or uneven heat on plaster.
2. Maintain relative humidity levels for prevailing ambient temperature that produces normal drying conditions.
3. Ventilate building spaces in a manner that prevents drafts of air from contacting surfaces during plaster application and until it is dry.

PART 2 - PRODUCTS

2.1 SPRAY-APPLIED CELLULOSIC INSULATION

A. Self-Supported, Spray-Applied Cellulosic Insulation (SAI-1): ASTM C1149, Type I (materials applied with liquid adhesive; suitable for either exposed or enclosed applications), chemically treated for flame-resistance, processing, and handling characteristics.

B. Material/Product: Provide K-13 by International Cellulose Corporation; TC-417 GP by ThermaCoustic Industries International Limited; or Architect approved equal; complying with the following:

1. Color: White.
2. Thickness: ASTM C518, apply at minimum thickness to achieve R-7.
3. NRC Rating: ASTM C423, apply at minimum thickness to achieve NRC-0.80.
4. Flame Spread and Smoke Density: Less than 25 flame spread and less than 50 smoke density per ASTM E84/UL 723.

C. Primers and Substrate Cleaners: As recommended by spray-applied product manufacturer.

1. Primer shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.2 SPRAY-APPLIED FIBER INSULATION (CONTRACTOR'S OPTION)

A. Material/Product: Provide MONOGLASS Spray-On White Fiber conforming to CAN 4-S114-78 and ASTM E136 using MONOGLASS Liquid Bonding Adhesive manufactured by Monoglass Incorporated.

B. Thermal /acoustic insulation shall not contain asbestos, free crystalline silica or combustible fibers, and shall exhibit the following properties:

PROPERTY	TEST METHOD	RESULTS
Fire Hazard Classification	ASTM E84	Flame Spread = 0Smoke Developed = 0 Fuel Contribution = 0
Non-Combustibility	ASTM E136, ISO 1182-90 & CAN 4-S114-78	Non-Combustible
Air Erosion	ASTM E859	No Mass Loss
Smolder Resistance	CGSB 51-GP-36P	Passed: 0.4% mean weight loss
Vibration Resistance Type 1	CGSB 51GP-11M	Passed: 0.02% mass loss
Dry Density	ASTM D-1622-83	3.0 pounds/cubic foot
Thermal Conductivity	ASTM C518	K-Factor .25, R-Value 4.00/inch
Noise Reduction Coefficient	ASTM C423	NRC = .85, 1.4" on solid backing
	ISO 354	NRC = .75 @ 25mm/1"* NRC = .95 @ 50mm/2"*
Fire Gas Toxicity	University of Pittsburgh Protocol	Max CO2 3.5%, Max CO 0.3%
Fungus & Bacterial Resistance	ASTM G-21-90	No Growth

C. Adhesive: MONOGLASS Bonding Adhesive shall be mixed with fresh, clean water to the exact proportions recommended by the manufacturer.

1. Adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

E. Spray-Applied Insulation: Apply spray-applied insulation according to manufacturer's written instructions. Do not apply insulation until installation of pipes, ducts, conduits, wiring, and electrical outlets in walls is completed and windows, electrical boxes, and other items not indicated to receive insulation are masked. After insulation is applied, make flush with face of studs by using method recommended by insulation manufacturer.

3.3 CLEANING AND PROTECTION

A. Remove temporary protection and enclosure of other work. Promptly remove plaster from door frames, windows, and other surfaces not indicated to be plastered. Repair floors, walls, and other surfaces stained, marred, or otherwise damaged during plastering.

END OF SECTION 09 81 20

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Back-mounted acoustical wall panels.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 06 10 00 - ROUGH CARPENTRY for wood blocking.
2. Section 09 51 00 - ACOUSTICAL CEILINGS for acoustical ceiling panels supported by exposed suspension system and tested for noise reduction.

1.3 DEFINITIONS

A. NRC: Noise reduction coefficient.

1.4 SUBMITTALS

A. Product Data: For each type of panel edge, core material, and mounting indicated.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating costs for each product having recycled content.

C. Shop Drawings: For acoustical wall panels. Include mounting devices and details; details at panel head, base, joints, and corners; and details at ceiling, floor base, and wall intersections. Include elevations showing panel sizes and direction of fabric weave and pattern matching. Indicate panel edge and core materials.

D. Coordination Drawings: Show intersections with wall base, electrical receptacles and switches, and other adjacent work.

E. Samples for Initial Selection: For each type of fabric facing material from acoustical wall panel manufacturer's full range.

F. Samples for Verification: For the following products. Prepare Samples from same material to be used for the Work.

1. Fabric: Full-width by 36-inch-long Sample from dye lot to be used for the Work, and as follows:
   a. With specified treatments applied.
   b. Show complete pattern repeat.
   c. Mark top and face of fabric.
2. Panel Edge: 12-inch-long Sample showing edge profile, corner, and finish.
3. Core Material: 12-inch-square Sample showing corner.
4. Mounting Device: Full-size Sample.
5. Sample Panels: No larger than 36 by 36 inches. Show joints and mounting methods.

G. Product Certificates: For each type of acoustical wall panel, signed by product manufacturer.

H. Qualification Data: For fabricator and testing agency.

I. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each type of acoustical wall panel.

J. Maintenance Data: For acoustical wall panels to include in maintenance manuals. Include fabric manufacturers' written cleaning and stain-removal recommendations.

K. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

B. Source Limitations: Obtain acoustical wall panels through one source from a single manufacturer.

C. Fire-Test-Response Characteristics: Provide acoustical wall panels with the following surface-burning characteristics as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Comply with fabric and acoustical wall panel manufacturers' written instructions for minimum and maximum temperature and humidity requirements for shipment, storage, and handling.

B. Deliver materials and panels in unopened bundles and store in a temperature-controlled dry place with adequate air circulation.

C. Protect panel edges from crushing and impact.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install acoustical wall panels until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Lighting: Do not install acoustical wall panels until a permanent level of lighting is provided on surfaces to receive acoustical wall panels.

C. Air-Quality Limitations: Protect acoustical wall panels from exposure to airborne odors, such as tobacco smoke, and install panels under conditions free from odor contamination of ambient air.

D. Field Measurements: Verify locations of acoustical wall panels by field measurements before fabrication and indicate measurements on Shop Drawings.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of acoustical wall panels that fail in performance, materials, or workmanship within specified warranty period.

1. Failure in performance includes, but is not limited to, acoustical performance.
2. Failures in materials include, but are not limited to, fabric sagging, distorting, or releasing from panel edge; or warping of core.
3. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers that may be incorporated into the Work include, but are not limited to, the following:

1. Decoustics Ltd.
2. Kinetics Noise Control.
3. MBI Products Company.
4. Quiet Concepts, a division of PCI Industries.
5. Sound Concepts.
6. Wall Technology, an Owens Corning Company.

2.2 CORE MATERIALS

A. Glass-Fiber Board: ASTM C 612, Type IA or Types IA and IB; density as specified, unfaced, dimensionally stable, molded rigid board, with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.

1. Nominal Core Density: 4 to 7 lb/cu. ft.

2.3 BACK-MOUNTED, EDGE-REINFORCED ACOUSTICAL WALL PANELS WITH GLASS-FIBER BOARD CORE

A. Panel Construction: Manufacturer's standard panel construction consisting of facing material laminated to front face, edges, and back border of dimensionally stable, rigid glass-fiber board core; with edges chemically hardened to reinforce panel perimeter against warpage and damage.

1. Nominal Core Thickness: 1 inch
2. Overall System NRC: Not less than 0.80, for Type A mounting per ASTM E 795.
3. Panel Width: As indicated on Drawings
4. Panel Height: Fabricated height as indicated on Drawings.
5. Panel Edge Detail: Square.
6. Corner Detail: Square to form continuous profile to match edge detail.

B. Facing Material: Fabric from same dye lot; color and pattern as selected by Architect from manufacturer's full range.

1. Manufacturer: As indicated on the Finish Schedule.

C. Back-Mounting Devices: Concealed on backside of panel, recommended to support weight of panel, and as follows:

1. As recommended by manufacturer.

2.4 FABRICATION

A. Sound-Absorption Performance: Provide acoustical wall panels with minimum NRCs indicated, as determined by testing per ASTM C 423 for mounting type specified.

B. Acoustical Wall Panels: Panel construction consisting of facing material adhered to[face,] edges and back border of dimensionally stable core; with rigid edges to reinforce panel perimeter against warpage and damage.

1. Glass-Fiber Board: Resin harden areas of core for attachment of mounting devices.

C. Fabric Facing: Stretched straight, on the grain, tight, square, and free from puckers, ripples, wrinkles, sags, blisters, seams, adhesive, or other foreign matter. Applied with visible surfaces fully covered.

1. Where square corners are indicated, tailor corners.
2. Where radius or other nonsquare corners are indicated, attach facing material so there are no seams or gathering of material.
3. Where fabrics with directional or repeating patterns or directional weave are indicated, mark fabric top and attach fabric in same direction so pattern or weave matches in adjacent panels.

D. Dimensional Tolerances of Finished Units: Plus or minus 1/16 inch for the following:

1. Thickness.

2. Edge straightness.
3. Overall length and width.
4. Squareness from corner to corner.
5. Chords, radii, and diameters.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fabric, substrates, blocking, and conditions, with Installer present, for compliance with requirements, installation tolerances, and other conditions affecting performance of acoustical wall panels.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install acoustical wall panels in locations indicated with vertical surfaces and edges plumb, top edges level and in alignment with other panels, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.

B. Comply with acoustical wall panel manufacturer's written instructions for installation of panels using type of concealed mounting accessories indicated or, if not indicated, as recommended by manufacturer. Anchor panels securely to supporting substrate.

C. Match and level fabric pattern and grain among adjacent panels.

D. Installation Tolerances: As follows:

1. Variation from Level and Plumb: Plus or minus 1/16 inch.
2. Variation of Panel Joints from Hairline: Not more than 1/16 inch wide.

3.3 CLEANING

A. Clip loose threads; remove pills and extraneous materials.

B. Clean panels with fabric facing, on completion of installation, to remove dust and other foreign materials according to manufacturer's written instructions.

3.4 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, to ensure that acoustical wall panels are without damage or deterioration at time of Substantial Completion.

B. Replace acoustical wall panels that cannot be cleaned and repaired, in a manner approved by Architect, before time of Substantial Completion.

END OF SECTION 09 84 30

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Field painting of exposed interior items and surfaces.
2. Field painting of exposed exterior items and surfaces.
3. Surface preparation for painting.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 05 12 00 - STRUCTURAL STEEL FRAMING for shop priming structural steel.
2. Section 05 50 00 - METAL FABRICATIONS for shop priming ferrous metal.
3. Section 06 40 20 - INTERIOR ARCHITECTURAL WOODWORK for shop priming interior architectural woodwork.
4. Section 08 11 10 - HOLLOW METAL DOORS AND FRAMES for factory priming steel doors and frames.
5. Section 08 14 00 - FLUSH WOOD DOORS for factory finishing and factory priming of wood doors.
6. Section 09 21 10 - GYPSUM BOARD ASSEMBLIES for surface preparation of gypsum board.

1.3 DEFINITIONS AND EXTENT

A. General: Standard coating terms defined in ASTM D 16 apply to this Section.

1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.
2. Eggshell refers to low-sheen finish with a gloss range between 20 and 35 when measured at a 60-degree meter.
3. Semigloss refers to medium-sheen finish with a gloss range between 35 and 70 when measured at a 60-degree meter.
4. Full gloss refers to high-sheen finish with a gloss range more than 70 when measured at a 60-degree meter.

B. This Section includes surface preparation and field painting of exposed exterior and interior items and surfaces.

1. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.

C. Paint exposed surfaces, except where these Specifications indicate that the surface or material is not to be painted or is to remain natural. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces. If a color of finish is not indicated, Architect will select from standard colors and finishes available.

1. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron supports, and surfaces of mechanical and electrical equipment that do not have a factory-applied final finish.

D. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.

1. Prefinished items include the following factory-finished components:

a. Architectural woodwork.
b. Acoustical wall panels.
c. Metal toilet enclosures.
d. Metal lockers.
e. Kitchen appliances.
f. Elevator entrance doors and frames.
g. Elevator equipment.
h. Finished mechanical and electrical equipment.
i. Light fixtures.

2. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:

a. Foundation spaces.
b. Furred areas.
c. Ceiling plenums.
d. Utility tunnels.
e. Pipe spaces.
f. Duct shafts.
g. Elevator shafts.

3. Finished metal surfaces include the following:

a. Anodized aluminum.
b. Stainless steel.
c. Chromium plate.
d. Copper and copper alloys.
e. Bronze and brass.

4. Operating parts include moving parts of operating equipment and the following:

a. Valve and damper operators.

b. Linkages.
c. Sensing devices.
d. Motor and fan shafts.

5. Labels: Do not paint over UL, FMG, or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

1.4 SUBMITTALS

A. Product Data: For each paint system indicated. Include block fillers and primers.

1. Material List: An inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
2. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.

B. LEED Submittals:

1. For Credit IEQ 4.2: Manufacturers' product data for paints, including printed statement of VOC content.

C. Samples for Verification: For each color and material to be applied, with texture to simulate actual conditions, on representative Samples of the actual substrate.

1. Provide stepped Samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing Samples for review. Resubmit until required sheen, color, and texture are achieved.
2. Provide a list of materials and applications for each coat of each Sample. Label each Sample for location and application.
3. Submit two eight inch by 12 inch Samples for each type of finish coating for Architect's review of color and texture only.

D. Qualification Data: For Applicator.

1.5 QUALITY ASSURANCE

A. Applicator Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.

B. Source Limitations: Obtain block fillers and primers for each coating system from the same manufacturer as the finish coats.

C. Mockups: Provide a full-coat benchmark finish sample for each type of coating and substrate required. Comply with procedures specified in PDCA P5. Duplicate finish of approved sample Submittals.

1. Architect will select one room or surface to represent surfaces and conditions for application of each type of coating and substrate.

a. Wall Surfaces: Provide samples on at least 100 sq. ft.

b. Small Areas and Items: Architect will designate items or areas required.

2. Apply benchmark samples, according to requirements for the completed Work, after permanent lighting and other environmental services have been activated. Provide required sheen, color, and texture on each surface.

a. After finishes are accepted, Architect will use the room or surface to evaluate coating systems of a similar nature.

3. Final approval of colors will be from benchmark samples.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:

1. Product name or title of material.
2. Product description (generic classification or binder type).
3. Manufacturer's stock number and date of manufacture.
4. Contents by volume, for pigment and vehicle constituents.
5. Thinning instructions.
6. Application instructions.
7. Color name and number.
8. VOC content.

B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F. Maintain storage containers in a clean condition, free of foreign materials and residue.

1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily.

1.7 PROJECT CONDITIONS

A. Apply waterborne paints only when temperatures of surfaces to be painted and surrounding air are between 50 and 90 deg F.

B. Apply solvent-thinned paints only when temperatures of surfaces to be painted and surrounding air are between 45 and 95 deg F.

C. Do not apply paint in snow, rain, fog, or mist; or when relative humidity exceeds 85 percent; or at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work are listed in the Finish Schedule at the end of this Section.

2.2 PAINT MATERIALS, GENERAL

A. Material Compatibility: Provide block fillers, primers, and finish-coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.

1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.

C. VOC Content for Interior Paints and Coatings: Products shall comply with VOC limits of authorities having jurisdiction and, for interior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 150 g/L.
3. Dry-Fog Coatings: 400 g/L.
4. Primers, Sealers, and Undercoaters: 200 g/L.
5. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
6. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
7. Pretreatment Wash Primers: 420 g/L.
8. Floor Coatings: 100 g/L.
9. Shellacs, Clear: 730 g/L.
10. Shellacs, Pigmented: 550 g/L.

D. Colors – Basis-of-Design:

1. PNTD-1 / Paint #1: Benjamin Moore, Natura - NO VOC, Light Neutral
2. PNTD-2 / Paint #2: Benjamin Moore, Natura - NO VOC, Dark Neutral
3. PNTD-3 / Paint #3: Benjamin Moore, Natura - NO VOC, Accent
4. PNTD-4 / Paint #4: Benjamin Moore, Natura - NO VOC, Off White
5. PNTD-5 / Paint #5: Benjamin Moore, Natura - NO VOC, CLG WHITE
6. PNTD-6 / Paint #6: Benjamin Moore, Natura - NO VOC, Medium Gray - Reveal Color

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for paint application.

1. Proceed with paint application only after unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
2. Start of painting will be construed as Applicator's acceptance of surfaces and conditions within a particular area.

B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.

1. Notify Architect about anticipated problems when using the materials specified over substrates primed by others.

3.2 PREPARATION

A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of size or weight of the item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.

B. Cleaning: Before applying paint or other surface treatments, clean substrates of substances that could impair bond of the various coatings. Remove oil and grease before cleaning.

1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

C. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.

1. Provide barrier coats over incompatible primers or remove and reprime.
2. Cementitious Materials: Prepare concrete, concrete unit masonry, cement plaster, and mineral-fiber-reinforced cement panel surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.

a. Use abrasive blast-cleaning methods if recommended by paint manufacturer.
b. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces if moisture content exceeds that permitted in manufacturer's written instructions.

c. Clean concrete floors to be painted with a 5 percent solution of muriatic acid or other etching cleaner. Flush the floor with clean water to remove acid, neutralize with ammonia, rinse, allow to dry, and vacuum before painting.

3. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.

a. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
b. Prime, stain, or seal wood to be painted immediately on delivery. Prime edges, ends, faces, undersides, and back sides of wood, including cabinets, counters, cases, and paneling.
c. If transparent finish is required, backprime with spar varnish.
d. Backprime paneling on interior partitions where masonry, plaster, or other wet wall construction occurs on back side.
e. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately on delivery.

4. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC's recommendations.

a. Blast steel surfaces clean as recommended by paint system manufacturer and according to SSPC-SP 6/NACE No. 3.
b. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.

5. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.

D. Material Preparation: Mix and prepare paint materials according to manufacturer's written instructions.

1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
3. Use only thinners approved by paint manufacturer and only within recommended limits.

E. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.3 APPLICATION

A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.

1. Paint colors, surface treatments, and finishes are indicated in the paint schedules.
2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
3. Provide finish coats that are compatible with primers used.
4. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, grilles, convector covers, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.
5. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
6. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
7. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
8. Finish exterior doors and doors in wet areas on tops, bottoms, and side edges the same as exterior faces.
9. Sand lightly between each succeeding enamel or varnish coat.

B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
2. Omit primer over metal surfaces that have been shop primed and touchup painted.
3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.

C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.

1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
2. Rollers: Use rollers of carpet, velvet-back, or high-pile sheep's wool as recommended by manufacturer for material and texture required.
3. Spray Equipment: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.

D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.

E. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and occupied spaces.

F. Mechanical items to be painted include, but are not limited to, the following:

1. Uninsulated metal piping.
2. Uninsulated plastic piping.
3. Pipe hangers and supports.
4. Tanks that do not have factory-applied final finishes.
5. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
6. Duct, equipment, and pipe insulation having "all-service jacket" or other paintable jacket material.
7. Mechanical equipment that is indicated to have a factory-primed finish for field painting.

G. Electrical items to be painted include, but are not limited to, the following:

1. Switchgear.
2. Panelboards.
3. Electrical equipment that is indicated to have a factory-primed finish for field painting.

H. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.

I. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.

J. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

K. Transparent (Clear) Finishes: Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, runs, cloudiness, color irregularity, brush marks, orange peel, nail holes, or other surface imperfections.

1. Provide satin finish for final coats.

L. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

3.4 FIELD QUALITY CONTROL

A. The Owner reserves the right to invoke the following test procedure at any time and as often as the Owner deems necessary during the period when paint is being applied:

1. The Owner will engage a qualified independent testing agency to sample paint material being used. Samples of material delivered to Project will be taken, identified, sealed, and certified in the presence of Contractor.

2. Testing agency will perform appropriate tests for the following characteristics as required by the Architect.
3. The Architect may direct Contractor to stop painting if test results show material being used does not comply with specified requirements. Contractor shall remove noncomplying paint from Project site, pay for testing, and repaint surfaces previously coated with the noncomplying paint. If necessary, Contractor may be required to remove noncomplying paint from previously painted surfaces if, on repainting with specified paint, the two coatings are incompatible.

3.5 CLEANING

A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from Project site.

1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping without scratching or damaging adjacent finished surfaces.

3.6 PROTECTION

A. Protect work of other trades, whether being painted or not, against damage from painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.

B. Provide "Wet Paint" signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings provided by others to protect their work.

1. After work of other trades is complete, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

3.7 PAINT SCHEDULE

A. Schedule: Provide products and number of coats specified. Use of manufacturer's proprietary product names to designate colors, materials, generic class, standard of quality and performance criteria and is not intended to imply that products named are required to be used to the exclusion of equivalent performing products of other manufacturers.

B. Exterior Paint Schedule:

1. Exterior Galvanized Metal (not shop-finished under Section 05 12 00 - STRUCTURAL STEEL FRAMING or Section 05 50 00 - METAL FABRICATIONS):
(Surface Preparation: SSPC-SP7 Brush-off Blast)

One Coat
1. Tnemec N69 Epoxoline at 3.0 mils DFT
2. PPG PMC Amerlock 400 Hi-Build Epoxy at 4.0-5.0 mils DFT
3. Dupont 25P High Solids at 4.0 mils DFT
4. International Intergard 475 HS at 5.0 to 10.0 mils DFT
5. Devoe Coatings: Devran 224HS at 4.0 – 6.0 mils DFT

And One Coat
1. Tnemec V73 Endura-Shield at 3.0 mils DFT
2. PPG PMC Amercoat 450H Polyurethane at 3.0 mils DFT
3. Dupont Imron 2.8 Urethane at 3.0 to 4.0 mils DFT
4. International Interthane 990 HS at 3.0 to 4.0 mils DFT

5. Devoe Coatings: Devthane 379 at 3.0 mils DFT

C. Interior Paint Schedule for Standard Performance Coatings:

1. Interior Gypsum Wallboard for Latex Eggshell Finish:

One Coat
1. Moore Ecospec Interior Latex Primer Sealer (231)
2. Duron Genesis Latex Primer
3. S-W Harmony Latex Wall Primer
4. PPG Pure Performance Latex Primer

And Two Coats
1. Moore Pristine Ecospec Interior Latex Eggshell (223)
2. Duron Genesis Latex Eggshell
3. S-W Harmony Latex Eggshell
4. PPG Pure Performance Latex Eggshell

2. Interior Gypsum Wallboard Ceilings for Latex Flat Finish:

One Coat
1. Moore Ecospec Interior Latex Primer Sealer (231)
2. Duron Genesis Latex Primer
3. S-W Harmony Latex Wall Primer
4. PPG Pure Performance Latex Primer

And Two Coats
1. Moore Pristine Ecospec Interior Latex Flat (219)
2. Duron Genesis Latex Flat
3. S-W Harmony Latex Flat
4. PPG Pure Performance Latex Eggshell

3. Interior Gypsum Wallboard for Latex Semi-Gloss Finish:

One Coat
1. Moore Ecospec Interior Latex Primer Sealer (231)
2. Duron Genesis Latex Primer
3. S-W Harmony Latex Wall Primer
4. PPG Pure Performance Latex Primer

And Two Coats
1. Moore Pristine Ecospec Interior Latex Semi-Gloss (224)
2. Duron Genesis Latex Semi-Gloss
3. S-W Harmony Latex Semi-Gloss
4. PPG Pure Performance Latex Semi-Gloss

4. Interior Concrete Masonry Units for Latex Semi-Gloss Finish in Dry Areas:

One Coat
1. PPG Speedhide Int/Ext Latex Block Filler (28g/l VOC formulation.)
2. S-W Loxon Block Surfacer

And Two Coats
1. PPG Pure Performance Latex Semi-Gloss
2. S-W Harmony Latex Semi-Gloss

5. Interior Wood Doors for Latex Semi-Gloss Paint Finish (softwoods, paint grade hardwoods, MDO, and hardwood veneers):

One Coat
1. Moore Eco Spec WB Interior Latex Primer (372)
2. Duron Genesis Latex Primer
3. S-W Harmony Latex Primer
4. PPG Pure Performance Latex Primer

And Two Coats
1. Moore Eco Spec WB Interior Latex Semi-Gloss (376)
2. Duron Genesis Latex Semi-Gloss
3. S-W Health Spec Latex Semi-Gloss
4. PPG Pure Performance Latex Semi-Gloss

D. Interior Paint Schedule for High Performance Coatings:

1. Interior Concrete Block, Epoxy/Urethane Coating:
(Surface Preparation: Cured, clean and dry, free of surface contaminants)

One Coat
1. Tnemec 130 Envirofil at 100 sqft/gal
2. PPG PMC Nu-Klad 114A at 100 sqft/gal
3. Dupont 25P at 100 sq/ft/gal
4. International Intercryl 320 at 80 sqft/gal
5. Devoe Coatings: Bloxfil 4000 at 100 sq. ft/gal

And One Coat
1. Tnemec 280 Tneme- glaze at 6.0 8.0 mils DFT
2. PPG PMC Amercoat 133 6.0 to 8.0 mils DFT
3. Dupont 100% Solids Epoxy at 7.0 to 9.0 mils DFT
4. International InterH2O 735 at 8.0 to 10.0 mils DFT
5. Devoe Coatings: Devran 724 at 4.0 to 6.0 mils DFT

And One Coat:
1. Tnemec 1080 Endura-Shield at 3.0 to 4.0 mils DFT
2. PPG PMC Amercoat 335 at 3.0 to 4.0 mils DFT
3. Dupont Imron WB Urethane at 3.0 to 4.0 mils DFT
4. International Water Borne Urethane at 3.0 to 4.0 mils DFT
5. Devoe Coatings Devthane 378H Urethane at 2.0 to 3.0 mils DFT

2. Interior Metals, Epoxy (Not specified to receive other coating systems/not shop finished):

One Coat
1. Approved primer, in shop under other Sections (where specified). If not shop primed, provide primer recommended by finish coating manufacturer

And One Coat
1. Tnemec N69 Epoxoline at 2.0 mils DFT
2. PPG PMC Amerlock 400 at 2.0 to 4.0 mils DFT
3. Dupont 25P at 3.0 to 4.0 mils DFT
4. International Interseal 670 HS at 3.0 mils DFT

And One Coat
1. Tnemec 29 Tufcryl at 2.0 to 3.0 mils DFT
2. PPG PMC Amerlock 400 at 2.0 to 4.0 mils DFT
3. Dupont High Solids Acrylic Coating 3.0 mils DFT
4. International Intercryl 530 at 3.0 to 4.0 mils DFT

3. Interior Exposed Steel, Joists, Ductwork, Conduit and Similar Items (where indicated):

One Coat
1. Tnemec 115 WB Unibond or 15 Unibond at 2.5 to 3.0 mils DFT

2. PPG PMC Amercoat 220 Acrylic at 3.0 mils DFT
3. International Intercryl 530 at 2.5 to 3.0 mils DFT

4. Mechanical and Electrical Work: Paint all exposed items throughout the project except factory finished items with factory-applied baked enamel finishes which occur in mechanical rooms or areas, and excepting chrome or nickel plating, stainless steel, and aluminum other than mill finished. Paint all exposed ductwork and inner portion of all ductwork: Same as specified for other interior metals, hereinabove.

END OF SECTION 09 90 00

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Markerboards for dry erase writing and projection screens, framed.
2. Tackboards.
3. Marker wall covering for dry erase writing and projection screens, full wall application.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 06 40 20 - INTERIOR ARCHITECTURAL WOODWORK for custom wood trim for visual display surfaces.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. LEED Submittals:

1. Credit IEQ 4.1: Manufacturers' product data for adhesives and sealants, including printed statement of VOC content and MSDS sheets.
2. Credit IEQ 4.4: Composite wood manufacturer's product data for each composite wood product used indicating that the bonding agent contains no urea formaldehyde. Adhesive manufacturer's product data for each adhesive used indicating that the adhesive contains no urea formaldehyde.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Show location of panel joints and seams in wall covering.
2. Show location of special-purpose graphics for visual display surfaces.
3. Include sections of typical trim members.

D. Maintenance Data: For visual display surfaces to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative of motor-operated, sliding visual display unit manufacturer for installation and maintenance of units required for this Project.

B. Source Limitations: Obtain each type of visual display surface through one source from a single manufacturer.

C. Fire-Test-Response Characteristics: Provide fabrics with the surface-burning characteristics indicated, as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.

D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver factory-built visual display boards, including factory-applied trim where indicated, completely assembled in one piece without joints, where possible. If dimensions exceed maximum manufactured panel size, provide two or more pieces of equal length as acceptable to Design Professional. When overall dimensions require delivery in separate units, prefit components at the factory, disassemble for delivery, and make final joints at the site.

B. Store visual display units vertically with packing materials between each unit.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating visual display surfaces without field measurements. Coordinate wall construction to ensure that actual dimensions correspond to established dimensions.
2. Allow for trimming and fitting where taking field measurements before fabrication might delay the Work.

PART 2 - PRODUCTS

2.1 MARKERBOARD ASSEMBLIES

A. Porcelain-Enamel Markerboard Assembly: Balanced, high-pressure, factory-laminated markerboard assembly of 3-ply construction consisting of backing sheet, core material, and 0.021-inch-thick, porcelain-enamel face sheet with low-gloss finish suitable for projectiom.

1. Available Manufacturers:
   a. AACRO Products, Inc.
   b. Best-Rite Manufacturing.
   c. Claridge Products & Equipment, Inc.
   d. PolyVision Corporation.

2. Basis-of-Design: LCS II Markerboard with #75 Low-Gloss Surface by Claridge.

B. Manufacturer's Standard Core: Minimum 1/4 inch thick, with manufacturer's standard moisture-barrier backing with binder containing no urea formaldehyde.

1. LEED Requirements: Do not use composite wood or agrifiber products containing added urea-formaldehyde resins.

C. Laminating Adhesive: Manufacturer's standard moisture-resistant thermoplastic type.

2.2 TACK ASSEMBLIES

A. Linoleum Resilient Tackboard (VDS-2): Uni-color linoleum resilient homogeneous tackable surface consisting of linseed oil, granulated cork, rosin binders and dry pigments calendared onto a natural burlap backing with integral color throughout with surface-burning characteristics indicated.

1. Available Manufacturers:
   a. Forbo Industries; Bulletin Board.
   b. WallTalkers; Tac-wall.
2. Basis-of-Design: #2182 by Forbo.
3. Thickness: 1/4 inch.
4. LEED Requirements: Do not use composite wood or agrifiber products containing added urea-formaldehyde resins.

2.3 VISUAL DISPLAY WALL COVERINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Egan Visual Inc.
2. Omnova Solutions Inc.; Decorative Products; Commercial Wallcovering.
3. WallTalkers; a division of RJF International Corporation.

B. Basis-of-Design: Nu-Write by WallTalkers.

C. Visual Display Wall Covering: Intended for use with dry-erase markers and as a projection surface and consisting of moderate-gloss, plastic film bonded to non-woven fabric backing; not less than 17-mil total thickness.

1. Color: Matte White.

D. Primer/Sealer: Mildew-resistant primer/sealer complying with requirements in Section 099000 - PAINTING AND COATING and recommended in writing by wall covering manufacturer for intended substrate.

2.4 ACCESSORIES

A. Aluminum Frames and Trim: Factory-applied, fabricated from not less than 0.062-inch-thick, extruded aluminum; of size and shape indicated.

1. Basis-of-Design: DIAPLAS 8mm 5/16” ART.#111 Natural Aluminum.

B. Chalktray: Manufacturer's standard, continuous.

C. Adhesive: Mildew-resistant, nonstaining adhesive, for use with specific tack wall panels and substrate application, as recommended in writing by visual display surface manufacturer, and with a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.5 FABRICATION

A. Porcelain-Enamel Visual Display Assemblies: Laminate porcelain-enamel face sheet and backing sheet to core material under heat and pressure with manufacturer's standard flexible, waterproof adhesive.

B. Factory-Assembled Visual Display Units: Coordinate factory-assembled units with trim and accessories indicated. Join parts with a neat, precision fit.

C. Aluminum Frames and Trim: Fabricate units straight and of single lengths, keeping joints to a minimum. Miter corners to neat, hairline closure.

2.6 ALUMINUM FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

D. Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 611.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove dirt, scaling paint, projections, and depressions that will affect smooth, finished surfaces of visual display boards.

B. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, and substances that will impair bond between visual display boards and surfaces.

3.3 INSTALLATION - BOARDS

A. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.

3.4 INSTALLATION - VISUAL DISPLAY WALL COVERING

A. General: Comply with visual display wall covering manufacturers' written installation instructions.

B. Minimize seams, review locations with Architect. Install seams horizontal and level, with lowest seam 24 inches above finished floor. Railroad fabric (reverse roll direction) to ensure color matching.

C. Double cut seams, with no gaps or overlaps. Remove air bubbles, wrinkles, blisters, and other defects.

D. After installation, clean visual display wall covering according to manufacturer's written instructions. Remove excess adhesive at finished seams, perimeter edges, and adjacent surfaces.

3.5 CLEANING AND PROTECTION

A. Clean visual display surfaces according to manufacturer's written instructions. Attach one cleaning label to visual display surface in each room.

B. Touch up factory-applied finishes to restore damaged or soiled areas.

C. Cover and protect visual display surfaces after installation and cleaning.

END OF SECTION 10 11 00

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Room and door signs.

B. Interior directional and informational signs.

C. Emergency evacuation maps.

D. Building identification signs.

1.02 REFERENCE STANDARDS

A. ANSI/ICC A117.1 - American National Standard for Accessible and Usable Buildings and Facilities; International Code Council; 2003.

B. ATBCB ADAAG - Americans with Disabilities Act Accessibility Guidelines; 2002.

1.03 SUBMITTALS

A. See Section 01 33 00 – Submittal Procedures, for Submittal Requirements and Procedures.

B. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, overall dimensions of each sign.

C. Signage Schedule: Provide information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.

1. When room numbers to appear on signs differ from those on the drawings, include the drawing room number on schedule.

2. When content of signs is indicated to be determined later, request such information from Owner through Architect at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.

3. Submit for approval by Owner through Architect prior to fabrication.

D. Samples: Submit two samples of each type of sign, of size similar to that required for project, illustrating sign style, font, and method of attachment.

E. Selection Samples: Where colors are not specified, submit two sets of color selection charts or chips.

F. Verification Samples: Submit samples showing colors specified.

G. Manufacturer's Installation Instructions: Include installation templates and attachment devices.

H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Package signs as required to prevent damage before installation.

B. Package room and door signs in sequential order of installation, labeled by floor or building.

C. Store tape adhesive at normal room temperature.

1.06 FIELD CONDITIONS

A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.

B. Maintain this minimum temperature during and after installation of signs.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Flat Signs:

1. Mohawk Sign Systems, Inc: www.mohawksign.com; Basis of Specification.

2. Best Sign Systems, Inc: www.bestsigns.com.

3. Seton Identification Products: www.seton.com/aec.

B. Dimensional Letter Signs: Exterior Building Signage

1. Same manufacturer

2.02 SIGNAGE APPLICATIONS

A. Accessibility Compliance: All signs are required to comply with ADAAG and ANSI/ICC A 117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.

B. Room and Door Signs: Provide a sign for every doorway, whether it has a door or not, not including corridors, lobbies, and similar open areas.

1. Sign Type: Flat signs with applied character panel media as specified.

2. Provide "tactile" signage, with letters raised minimum 1/32 inch and Grade II braille.

3. Character Height: As indicated on the drawings.

4. Sign Height: As indicated on the drawings.

5. Office Doors: Identify with room numbers to be determined later, not the numbers shown on the drawings; in addition, provide "window" section for replaceable occupant name.

6. Conference and Meeting Rooms: Identify with room numbers to be determined later, not the numbers shown on the drawings; in addition, provide "window" section with sliding "In Use/Vacant" indicator.

7. Service Rooms: Identify with room names and numbers to be determined later, not those shown on the drawings.

8. Rest Rooms: Identify with pictograms, the names "MEN" and "WOMEN", room numbers to be determined later, and braille.

C. Interior Directional and Informational Signs:

1. Sign Type: Same as room and door signs.

2. Allow for 20 signs 4 inches high by 16 inches long, or as indicated on the drawings.

3. Wording of signs is scheduled on the drawings.
4. Where suspended, ceiling mounted, or projecting from wall signs are indicated, provide two-sided signs with same information on both sides.

D. Emergency Evacuation Maps:
1. Allow for one map per elevator lobby.
2. Use clear plastic panel silk-screened on reverse, in brushed aluminum frame, screw-mounted.

E. Building Identification Signs:
1. Use individual metal letters, prefinished extruded aluminum.
a. Thickness: 4 inches
b. Height: As indicated on the drawings
2. Mount on outside roof in location shown on drawings.

2.03 SIGN TYPES

A. Flat Signs: Signage media without frame.
1. Edges: Square.
2. Corners: Square.
3. Wall Mounting of One-Sided Signs: Concealed screws.
4. Wall and Ceiling Mounting of Two-Sided Signs: Aluminum wall bracket, powder coated, color selected from manufacturer's standard colors, attached with screws in predrilled mounting holes, set in clear silicone sealant.
5. Suspended Mounting: Stainless steel suspension cables, cable clamps, and ceiling fastener suitable for attachment to ceiling construction indicated.

B. Color and Font: Unless otherwise indicated:
1. Character Font: Helvetica, Medium, or other sans serif font.
2. Character Case: Upper case only.
3. Background Color: as selected by the architect.
4. Character Color: as selected by the architect color.

2.04 TACTILE SIGNAGE MEDIA

A. Engraved Panels: Laminated colored plastic; engraved through face to expose core as background color:
1. Total Thickness: 1/8 inch.

B. Applied Character Panels: Acrylic plastic base, with applied acrylic plastic letters and braille.
1. Total Thickness: 1/8 inch.
2. Letter Thickness: 1/8 inch.
3. Letter Edges: Square.

2.05 NON-TACTILE SIGNAGE MEDIA

A. Silk Screened Plastic Panels: Letters and graphics silk screened onto reverse side of plastic surface:

1. Sign Color: Clear.

2. Total Thickness: 1/8 inch.

2.06 DIMENSIONAL LETTERS

A. Metal Letters:

1. Mounting: Concealed screw with prefinished extruded aluminum mounting rail.

2.07 ACCESSORIES

A. Concealed Screws: Stainless steel, galvanized steel, chrome plated, or other non-corroding metal.

B. Tape Adhesive: Double sided tape, permanent adhesive.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install neatly, with horizontal edges level.

C. Locate signs where indicated:

1. Room and Door Signs:

a. Locate tactile signs in compliance with ICC/ANSI Section 703.3.10, tactile characters shall be 48 inches minimum above the floor, measured to the baseline of the lowest tactile character and 60 inches maximum above the floor, measured to the baseline of the highest tactile character.

2. If no location is indicated obtain Owner's instructions.

D. Protect from damage until Substantial Completion; repair or replace damage items.

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Solid plastic toilet compartments and screens, floor-mounted and overhead braced.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 05 50 00 - METAL FABRICATIONS for framing and supports.
2. Section 10 28 00 - TOILET ACCESSORIES for partition mounted accessories.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. LEED Submittals:

1. Credit MR 4: Product data indicating percentage by weight of post-consumer and pre-consumer recycled content for products having recycled content. Include a statement indicating costs for each product having recycled content.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Show locations of cutouts for compartment-mounted toilet accessories.

D. Samples for Verification: Of each type of color and finish required for units, prepared on 6-inch-square Samples of same thickness and material indicated for Work.

1.4 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating toilet compartments without field measurements. Coordinate wall, floor, ceilings, and other contiguous construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 RECYCLED PLASTIC UNITS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Accurate Partitions Corporation.
2. Bradley Corporation; Mills Partitions.
3. General Partitions Mfg. Corp.
4. Global Partitions.
5. Scranton Products (Capitol, Comtec, and Santana).
6. Yemm & Hart Ltd.

B. Basis-of-Design: Scranton Products (Capitol, Comtec, and Santana).

C. Door, Panel, and Pilaster Construction: Solid, recycled high-density polyethylene (HDPE) material, not less than 1 inch thick, seamless, with eased edges, and with homogenous color and pattern throughout thickness of material.

1. Color and Pattern: One color and pattern in each room as selected by Architect from manufacturer's full range of colors and patterns.

D. Brackets and Fittings: Manufacturer's standard design.

1. Full-Height (Continuous) Type Brackets: Stainless steel.
2. Pilaster Shoes and Sleeves (Caps): Stainless-steel sheet, not less than 0.031-inch nominal thickness and 3 inches high, finished to match hardware.

2.2 ACCESSORIES

A. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories.

1. Material: Stainless steel.
2. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories.

B. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match hardware, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use hot-dip galvanized or other rust-resistant, protective-coated steel.

2.3 FABRICATION

A. Floor-Mounted, Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.

B. Door Size and Swings: Unless otherwise indicated, provide 24-inch-wide, in-swinging doors for standard toilet compartments and 36-inch-wide, out-swinging doors with a minimum 32-inch-wide, clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.

1. Maximum Clearances:

a. Pilasters and Panels: 1/2 inch.
b. Panels and Walls: 1 inch.

B. Floor-Mounted, Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels, and adjust so tops of doors are parallel with overhead brace when doors are in closed position.

C. Wall-Hung Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb and to resist lateral impact.

3.2 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware according to manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors and doors in entrance screens to return doors to fully closed position.

END OF SECTION 10 21 10

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Curtain tracks and curtain carriers.
2. Cubicle curtains, typical, blackout and laser types.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 06 10 00 - ROUGH CARPENTRY for wood blocking for mounting items requiring anchorage.

1.3 PERFORMANCE REQUIREMENTS

A. Curtains: Provide curtain fabrics with the following characteristics:

1. Fabrics are launderable to a temperature of not less than 160 deg F, except laser curtains may be hand washed with soap and water.
2. Fabrics are flame resistant and are identical to those that have passed NFPA 701 when tested by a testing and inspecting agency acceptable to authorities having jurisdiction.

a. Identify fabrics with appropriate markings of applicable testing and inspecting agency.

1.4 SUBMITTALS

A. Product Data: Include durability, laundry temperature limits, fade resistance, and fire-test-response characteristics for each type of curtain fabric indicated.

1. Include data on each type of applied curtain treatment.

B. Shop Drawings: Show layout and types of cubicles, sizes of curtains, number of carriers, anchorage details, and conditions requiring accessories. Indicate dimensions taken from field measurements.

1. Include details on blocking.

C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Suspended ceiling components.
2. Structural members to which suspension systems will be attached.
3. Items penetrating finished ceiling, including the following:

a. Lighting fixtures.
b. Air outlets and inlets.
c. Speakers.
d. Sprinklers.
e. Access panels.

D. Samples for Initial Selection: For each type of curtain material indicated.

E. Samples for Verification: For each type of product required, prepared on Samples of size indicated below.

1. Curtain Fabric: 12-inch-square swatch or larger as required to show complete pattern repeat, from dye lot used for the Work, with specified treatments applied. Mark top and face of material.
2. Mesh Top: Not less than 4 inches square.
3. Curtain Track: Not less than 4 inches long.
4. Curtain Carrier: Full-size unit.

F. Curtain and Track Schedule: Use same designations indicated on Drawings.

G. Manufacturer Certificates: Signed by manufacturers certifying that products comply with requirements.

H. Operation and Maintenance Data: For curtains, track, and hardware to include in operation and maintenance manuals.

1.5 PROJECT CONDITIONS

A. Environmental Limitations: Do not install cubicles until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

PART 2 - PRODUCTS

2.1 CUBICLE CURTAIN TRACKS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Crowder, K. N. Manufacturing, Inc.
2. Brite Visual Products, Inc.

3. General Cubicle, a C/S Group company.
4. InPro Corporation.
5. Nelson, A. R. Co.
6. Silent Gliss USA Inc.

B. Extruded-Aluminum Track: Not less than 1-1/4 inches wide by 3/4 inch high; with minimum wall thickness of 0.062 inch.

1. Finish: Satin anodized.

C. Track Accessories: Fabricate splices, end caps, connectors, end stops, coupling and joining sleeves, wall flanges, brackets, ceiling clips, and other accessories from same material and with same finish as track.

D. Curtain Carriers: Two nylon rollers and nylon axle with chrome-plated steel hook.

1. Basis of Design: General Cubicle; Track Carrier No. 1062N.

E. Exposed Fasteners: Stainless steel.

F. Concealed Fasteners: Stainless steel.

2.2 CURTAINS

A. Cubicle Curtain Fabric, Typical: Curtain manufacturer's standard, 100 percent polyester, inherently and permanently flame resistant, stain resistant, and antimicrobial.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. KoSa; Avora FR.
b. Trevira, R-M Schulz Consulting, Inc.; Trevira CS.

2. Pattern: As selected by the Architect.
3. Mesh Top: Nylon mesh.
4. Color: As selected by Architect.

B. Cubicle Curtain Fabric, Blackout Type: Coated nylon, 18 oz., opaque, room darkening fabric.

1. Basis of Design: Seaman Corp., Shelter-Rite Truck Tarps, Style 2118.
2. Color: As selected by Architect.

C. Cubicle Curtain Fabric, Laser Type: ANSI Z136.1; 34% SEF modacrylic, 32% Saran flat monofilament and 34% viscose rayon; double-vinyl laminated back for opacity.

1. Performance: Grade 4.
2. Color: As selected by Architect.

D. Curtain Grommets: Two-piece, rolled-edge, rustproof, nickel-plated brass; spaced not more than 6 inches o.c.; machined into top hem.

E. Curtain Tieback: Nickel-plated brass chain; one at each curtain termination.

2.3 CURTAIN FABRICATION

A. Fabricate curtains to comply with the following requirements:

1. Width: Equal to track length from which curtain is hung plus 10 percent added fullness, but not less than 12 inches added fullness.
2. Length: Equal to floor-to-ceiling height, and minus distance above the finished floor at bottom as follows:

a. Cubicle Curtains, Typical: 12 inches. Furnish with 20-inch mesh top.
b. Curtains, Blackout Type: Flush to floor.
c. Curtains, Laser Type: Flush to floor.

B. Vertical Seams: Not less than 1/2 inch wide, double turned and double stitched.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance of work.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install tracks level and plumb, according to manufacturer's written instructions.

B. Provide track fabricated from 1 continuous length.

1. Curtain Track Mounting: As indicated on Drawings.

C. Track Accessories: Install splices, end caps, connectors, end stops, coupling and joining sleeves, and other accessories as required for a secure and operational installation.

1. Provide one locking switch unit for each pair of beds.
2. Provide one hinged loading unit for each bed.

D. Curtain Carriers: Provide curtain carriers adequate for 6-inch spacing along full length of curtain plus an additional carrier.

E. Curtains: Hang curtains on each curtain track. Secure with curtain tieback.

3.3 PROTECTION

A. Protect installed recessed track openings with nonresidue adhesive tape to prevent construction debris from impeding carrier operation. Remove tape prior to Substantial Completion.

END OF SECTION 10 21 23

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Chain-link partitions and swinging gate.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 018110, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 087100 - DOOR HARDWARE for lock cylinders and keying.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design chain-link fences and gates, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Chain-link fence and gate framework shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to ASCE/SEI 7:

1. Minimum Post Size: Determine according to ASTM F 1043 for framework up to 12 feet high, and post spacing not to exceed 10 feet for material group IA, ASTM F 1043, Schedule 40 steel pipe .

1.4 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for wire mesh items.

B. LEED Submittals:

1. Product Data for Credit MR 4: Indicating percentages by weight of postconsumer and preconsumer recycled content for products having recycled content. Include statement indicating costs for each product having recycled content.

2. For Credit IEQ 4.2: Manufacturers' product data for paints, including printed statement of VOC content.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

D. Samples for Verification: 12-by-12-inch panel constructed of specified frame members and wire mesh. Show method of finishing members at intersections.

E. Delegated-Design Submittal: For chain-link fences and gate framework indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of construction contiguous with wire mesh items by field measurements before fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish location dimensions and proceed with fabricating wire mesh items without field measurements. Coordinate with adjacent construction to ensure that actual location dimensions correspond to established dimensions.

1.6 COORDINATION

A. Coordinate installation of anchorages for wire mesh items supported or anchored to permanent construction. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 CHAIN-LINK FABRIC

A. General: Provide fabric in one-piece heights measured between top and bottom of outer edge of selvage knuckle or twist. Comply with ASTM A 392, CLFMI CLF 2445, and requirements indicated below:

1. Steel Wire Fabric: Galvanized wire with a diameter of 0.192 inch.
   a. Mesh Size: 1” by 1” and 2” by 2”.
   b. Weight of Metallic (Zinc) Coating: ASTM A 392, Type II, Class 1, 1.2 oz./sq. ft. with zinc coating applied before weaving.
2. Selvage: Knuckled at both selvages.

2.2 FRAMING

A. Posts and Rails: Comply with ASTM F 1043 for framing, including rails, braces, and line; terminal; and corner posts. Provide members with minimum dimensions and wall thickness according to ASTM F 1043 or ASTM F 1083 based on the following:

1. Fence Height: As indicated on Drawings.
2. Light Industrial Strength: Material Group II-L, roll-formed steel C-section shapes.

a. Line Post: Minimum 1.9 inches in diameter.
b. End, Corner and Pull Post: Minimum 2.375 inches.

3. Metallic Coating for Steel Framing:
   a. Type A, consisting of not less than minimum 2.0-oz./sq. ft. average zinc coating per ASTM A 123/A 123M or 4.0-oz./sq. ft. zinc coating per ASTM A 653/A 653M.

2.3 SWING GATES

A. General: Comply with ASTM F 900 for gate posts and swing gate types.

B. Pipe and Tubing:

1. Zinc-Coated Steel: Comply with ASTM F 1043 and ASTM F 1083; [protective coating and finish to match fence framing] [manufacturer's standard protective coating and finish] <Insert finish>.
2. Gate Posts: Round tubular steel.
3. Gate Frames and Bracing: Round tubular steel.

C. Frame Corner Construction: Welded.

D. Hardware:

1. Hinges: 360-degree inward and outward swing.
2. Latches permitting operation from both sides of gate.
3. Lock: Manufacturer's standard internal device.

2.4 FITTINGS AND ACCESSOIRES

A. General: Comply with ASTM F 626.

B. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout, recommended in writing by manufacturer, for exterior applications.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Examine floors for suitable conditions where wire mesh items will be installed.

C. Examine walls to which chain link items will be attached for properly located blocking, grounds, and other solid backing for attachment of support fasteners.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ERECTION

A. Post Excavation: Drill holes for posts to diameters and spacings indicated, in firm, undisturbed soil.

B. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.

C. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach fabric as for fencing. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

3.3 ADJUSTING AND CLEANING

A. Adjust doors to operate easily without binding.

B. Check and readjust operating hardware items just before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work including doors and framing that are warped, bowed, or otherwise unacceptable.

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Bumper rails.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 018113, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 055000 - METAL FABRICATIONS.
2. Section 055750 - DECORATIVE FORMED METAL for laser-cut stainless steel corner guards.
3. Section 087100 - DOOR HARDWARE for metal armor, kick, mop, and push plates.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.

1. Bumper Rails: 12 inches long.

C. Maintenance Data: For each impact-resistant wall protection unit to include in maintenance manuals.

1. Include recommended methods and frequency of maintenance for maintaining optimum condition of plastic covers under anticipated traffic and use conditions. Include precautions against using cleaning materials and methods that may be detrimental to plastic finishes and performance.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain impact-resistant wall protection units from single source from single manufacturer.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of impact-resistant wall protection units and are based on the specific system indicated. Refer to Division 01 Sections.

1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

C. Surface-Burning Characteristics: Provide impact-resistant, plastic wall protection units with surface-burning characteristics as determined by testing identical products per ASTM E 84, NFPA 255, or UL 723 by UL or another qualified testing agency.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store impact-resistant wall protection units in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1. Maintain room temperature within storage area at not less than 70 deg F during the period plastic materials are stored.
2. Keep plastic sheet material out of direct sunlight.
3. Store plastic wall protection components for a minimum of 72 hours, or until plastic material attains a minimum room temperature of 70 deg F.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install impact-resistant wall protection units until building is enclosed and weatherproof, wet work is complete and dry, and HVAC system is operating and maintaining temperature at 70 deg F for not less than 72 hours before beginning installation and for the remainder of the construction period.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Stainless-Steel Sheet: ASTM A 240/A 240M.

B. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.

C. Adhesive: Type recommended by manufacturer for use with material being adhered to substrate indicated.

D. Adhesives, General: Do not use adhesives that contain urea formaldehyde.

E. VOC Limits for Installation Adhesives and Glues: Use installation adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Wood Glues: 30 g/L.

2. Contact Adhesive: 80 g/L.
3. Special Purpose Contact Adhesive: 250 g/L.

2.2 BUMPER RAILS

A. Surface-Mounted, Metal Bumper Rails: Fabricated from 1-piece, formed or extruded metal with formed edges.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. ARDEN Architectural Specialties, Inc.
   b. Balco, Inc.
   c. Boston Retail Products.
   d. Construction Specialties, Inc.
   e. IPC Door and Wall Protection Systems; Division of InPro Corporation.
   f. Korogard Wall Protection Systems; Division of RJF International Corporation.
   g. Pawling Corporation.

2. Material: Stainless steel, Type 304.

   a. Thickness: Minimum 0.0781 inch.
   b. Finish: Directional satin, No. 4.
3. Mounting: Flat-head, countersunk screws through factory-drilled mounting holes.

2.3 FABRICATION

A. Fabricate impact-resistant wall protection units to comply with requirements indicated for design, dimensions, and member sizes, including thicknesses of components.

B. Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.

C. Fabricate components with tight seams and joints with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

2.4 METAL FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Remove tool and die marks and stretch lines or blend into finish.
2. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.

B. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

C. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

2.5 STAINLESS-STEEL FINISHES

A. Remove tool and die marks and stretch lines or blend into finish.

B. Grind and polish surfaces to produce uniform, polished finish indicated, free of cross scratches.

1. Run grain of directionally textured finishes with long dimension of each piece.

C. Directional Satin Finish: No. 4 finish.

D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Examine walls to which impact-resistant wall protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Complete finishing operations, including painting, before installing impact-resistant wall protection system components.

B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

A. General: Install impact-resistant wall protection units level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.

1. Provide mounting hardware, anchors, and other accessories required for a complete installation.

3.4 CLEANING

A. Immediately after completion of installation, clean plastic covers and accessories using a standard, ammonia-based, household cleaning agent.

END OF SECTION 102610

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Toilet accessories as scheduled at the end of this Section.
   a. Coordinate with Owner for accessories provided by Owner.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 06 10 00 - ROUGH CARPENTRY for blocking.
2. Section 08 80 00 - GLAZING for frameless mirrors.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include the following:

1. Construction details and dimensions.
2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
3. Material and finish descriptions.
4. Features that will be included for Project.
5. Manufacturer's warranty.

B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.

1. Identify locations using room designations indicated on Drawings.
2. Identify products using designations indicated on Drawings.

C. Maintenance Data: For toilet accessories to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Source Limitations: For products listed together in the same articles in Part 2, provide products of same manufacturer unless otherwise approved by Architect.

1.5 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. A & J Washroom Accessories, Inc.
2. American Specialties, Inc.
3. Bobrick Washroom Equipment, Inc.
4. Bradley Corporation.
5. General Accessory Manufacturing Co. (GAMCO).
6. Kimberley Clarke.
7. Scott Restroom Equipment.

2.2 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, 0.0312-inch minimum nominal thickness, unless otherwise indicated.

B. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.0359-inch (0.9-mm) minimum nominal thickness.

C. Galvanized Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.

D. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.

2.3 FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to the Owner.

2.4 HAND DRYERS

A. High Velocity Warm Air Hand Dryers: Minimum 20,00 rpm motor/blower, minimum 900 watt heating element, activated by inreared optic sensor, providing an average drying time of 10 to 15 seconds. Unit shall be UL and Greenspecs listed.

B. Basis-of-Design: Xlerator Model XL-SB with recess mounting kit by Excel.

C. Acceptable Manufacturers:

1. World Dryer.
2. Excel.
3. Sloane Valve.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to method in ASTM F 446.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

3.3 TOILET AND BATH ACCESSORIES SCHEDULE

A. 42" Grab Bar: Bobrick No. B-6806.99 x 42, 1 1/2" diameter type 304 satin finished stainless steel with peened gripping surface, 1/8" thick welded type 304 stainless steel flanges each with mounting screw holes, and captive 3 1/4" diameter x 1/2" deep type 304 satin finished stainless steel snap-on flanges to conceal mounting screws.

B. 36" Grab Bar: Bobrick No. B-6806.99 x 36, 1 1/2" diameter type 304 satin finished stainless steel with peened gripping surface, 1/8" thick welded type 304 stainless steel flanges each with mounting screw holes, and captive 3 1/4" diameter x 1/2" deep type 304 satin finished stainless steel snap-on flanges to conceal mounting screws.

C. 24" Grab Bar: Bobrick No. B-6806.99 x 24, 1 1/2" diameter type 304 satin finished stainless steel with peened gripping surface, 1/8" thick welded type 304 stainless steel flanges each with mounting screw holes, and captive 3 1/4" diameter x 1/2" deep type 304 satin finished stainless steel snap-on flanges to conceal mounting screws.

D. 18" Grab Bar: Bobrick No. B-6806.99 x 18, 1 1/2" diameter type 304 satin finished stainless steel with peened gripping surface, 1/8" thick welded type 304 stainless steel flanges each with mounting screw holes, and captive 3 1/4" diameter x 1/2" deep type 304 satin finished stainless steel snap-on flanges to conceal mounting screws.

E. Swing Grab Bar: Bobrick No. B-4998.99, fabricated from 1 1/4" diameter type 304 satin finished stainless steel with peened gripping surface and a welded type 304 satin finished stainless steel flange with 4 countersunk screw holes for exposed mounting. Provide interrupted-slot-head screws for vandal-resistant mounting.

F. Liquid Soap Dispenser: University will provide this item to be installed by the contractor.

G. Toilet Tissue Dispenser: (For HC stall and HC restroom): Bobrick No. B-3888 Recessed multi-roll toilet tissue dispenser.

H. Toilet Tissue Dispenser:

I. Surface mounted double roll toilet tissue dispenser, Bobrick No. B-6867, two roll capacity, surfaced mounted, fabricated from type 304 satin finished stainless steel, 2” square flanges, 4” post projection, secured to concealed type 304 stainless steel wall plates with stainless steel lock screws. Provide plastic spindles with internal springs.

J. Toilet Tissue Dispenser: (Typical for Standard Stall) Kimberly Clarke #09612, Jumbo roll dispenser.

K. Toilet Tissue Dispenser: (For HC stall 3'-0" x 5'-0"): Bobrick No. B-2888 Partition surface mounted multi-roll dispenser.

L. Sanitary Napkin Disposal: Bobrick No. B-35303 Recessed sanitary napkin disposal.

M. Sanitary Napkin Disposal: Bobrick No. B-354 Partition mounted serves to compartments.

N. Sanitary Napkin Dispenser: Bobrick No. B-3500 25 Recessed sanitary napkin/tampon vendor.

O. Recessed Waste Receptacle: Bobrick B-3644..

P. Mirror: Bobrick No. B-165 2436 stainless steel channel mirror, one piece channel frame with polished finish and mitered corners. No. 1 quality 1/4” float/plate glass mirror.

Q. Trash Receptacle Liners: Rubbermaid, various sizes, gray color, for use in built-in trash receptacle

END OF SECTION 10 28 00

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Portable fire extinguishers.
2. Fire-protection cabinets for portable fire extinguishers.
3. Mounting brackets for fire extinguishers.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

1.3 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each item.

1. Fire Extinguishers: Include rating and classification.
2. Fire-Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.

B. Maintenance Data: For fire extinguishers and fire-protection cabinets to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain fire extinguishers and fire-protection cabinets through one source from a single manufacturer.

B. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

C. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

D. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements of ASTM E 814 for fire-resistance rating of walls where they are installed.

1.5 COORDINATION

A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

PART 2 - PRODUCTS

2.1 PORTABLE FIRE EXTINGUISHERS

A. General: Provide fire extinguishers of type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.

B. Multipurpose Dry-Chemical Type in Steel Container: UL-rated 2-A:10-B:C, 10-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

2.2 FIRE-PROTECTION CABINET

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. JL Industries, Inc.
2. Larsen's Manufacturing Company.
3. Potter Roemer; Div. of Smith Industries, Inc.

B. Cabinet Type: Suitable for fire extinguisher.

C. Cabinet Material: Enameled-steel sheet.

D. Recessed Cabinet: Cabinet box recessed in walls of sufficient depth to suit style of trim indicated.

1. Trimless with Plaster Stop: Surface of surrounding wall finishes flush with exterior finished surface of cabinet frame and door, without overlapping trim attached to cabinet. Provide recessed flange, of same material as box, attached to box to act as plaster stop. If wall condition does not allow for trimless with plaster stop, provide flat 5/16 inch trim of same material as the cabinet box.

E. Door Material: Steel sheet with baked enamel finish, color as selected.

F. Door Style: Vertical duo panel with frame.

G. Door Glazing: Tempered glass.

H. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

I. Accessories:

1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.

2. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.

2.3 MOUNTING BRACKETS

A. Mounting Brackets: Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.

B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.

2.4 FABRICATION

A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub), with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

1. Weld joints and grind smooth.
2. Construct fire-rated cabinets with double walls fabricated from 0.0428-inch-thick, cold-rolled steel sheet lined with minimum 5/8-inch-thick, fire-barrier material.

a. Provide factory-drilled mounting holes.

B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.

1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.
2. Miter and weld perimeter door frames.

C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.5 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Finish fire-protection cabinets after assembly.

D. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls and partitions for suitable framing depth and blocking where recessed cabinets will be installed.

B. Examine fire extinguishers for proper charging and tagging. Contractor shall be responsible for fire extinguisher tagging by a certified service technician located within 75 miles of the project.

1. Remove and replace damaged, defective, or undercharged units.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare recesses for recessed fire-protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

A. General: Install fire-protection specialties in locations and at mounting heights indicated on the Drawings and acceptable to authorities having jurisdiction.

B. Fire-Protection Cabinets: Fasten fire-protection cabinets to structure, square and plumb.

1. Unless otherwise indicated, provide recessed fire-protection cabinets. If wall thickness is not adequate for recessed cabinets, provide semirecessed fire-protection cabinets.
2. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.

C. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

D. Identification: Apply vinyl lettering at locations indicated.

3.4 INSTALLATION OF FIRE-RATED CABINETS

A. Install cabinet with not more than 1/16-inch tolerance between pipe OD and knockout OD. Center pipe within knockout.

B. Seal through penetrations with firestopping sealant as specified in Section 07 84 10 - PENETRATION FIRESTOPPING.

3.5 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as fire-protection specialties are installed, unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet manufacturer.

E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 10 44 00

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Phenolic lockers, double-tier, flat tops.
2. Locker benches.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and will be performed under the designated Sections:

1. Section 06 10 00 - ROUGH CARPENTRY for furring, blocking, and shims required for installing lockers and concealed within other construction before locker installation.
2. Division 26 – ELECTRICAL for electrical outlets mounted in lockers,

1.3 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of locker and bench.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Show base, top, trim and other accessories.
2. Include locker identification system.

C. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain lockers and accessories through one source from a single manufacturer.

B. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver lockers until spaces to receive them are clean, dry, and ready for locker installation.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify the following by field measurements before fabrication and indicate measurements on Shop Drawings:

1. Concealed framing, blocking, and reinforcements that support lockers before they are enclosed.
2. Recessed openings and overall dimensioning.

1.7 COORDINATION

A. Coordinate size and location of bases for lockers.

B. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that lockers can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 PHENOLIC LOCKERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. ASI Storage Solutions.
2. Hollman Inc.
3. Spec-Rite Design.

B. Panel Material for all Surfaces: Solid phenolic material with rounded corners, ASTM C 84 Class A fire-retardant treated.

1. Doors: 3/4 in. thick solid phenolic material.
2. Tops, bottoms, and intermediate shelves: 3/4 in. thick solid phenolic composite material with ventilation holes.
3. Locker Backs: 3/4 in. thick solid phenolic material.
4. Locker Sides: 3/4 in. thick solid phenolic composite material

C. Locker Body: Fabricated from particleboard-core panels covered on both sides with thermoset decorative overlay; curb-mounted.

D. End Panels: Match style, material, construction, and finish of doors.

E. Hinges: Self-closing; welded to door and attached to door frame with not less than 2 factory-installed rivets per hinge that are completely concealed and tamper resistant when door is closed; fabricated to swing 180 degrees.

F. Recessed Door Handle and Latch: Stainless-steel cup with integral door pull, recessed so locking device does not protrude beyond face of door; pry resistant.

1. Lock: Hasp for Owner provided padlocks.

G. Equipment: Equip units with identification plate.

H. Locker Configurations: Provide single tier, double tier, and z-shape lockers as indicated.

I. Accessories:

1. Recess Trim.
2. Filler Panels.

2.2 LOCKER BENCHES

A. General: Provide locker benches fabricated by same manufacturer as lockers, integral with locker base.

B. Bench Tops: Manufacturer's standard 1-piece units, with rounded corners and edges:

1. Material: Solid Phenolic.

2.3 FABRICATION

A. General: Fabricate lockers square, rigid, and without warp; with faces flat and free of dents or distortion.

1. Provide fasteners, filler plates, supports, clips, and closures as required for a complete installation.

B. Unit Principle: Fabricate each locker with an individual door and frame; individual top, bottom, and back; and common intermediate uprights separating compartments.

C. Hooks: Manufacturer's standard ball-pointed type, stainless steel.

D. Coat Rods: Fabricated from stainless steel.

E. Identification Plates: Manufacturer's standard etched, embossed, or stamped aluminum plates; with numbers and letters to comply with UMass Design guidelines.

F. Continuous Base: Fabricated in lengths as long as practicable to enclose base and base ends of lockers; finished to match lockers.

G. Filler Panels and Trim: Fabricated from same material as lockers. Provide slip joint filler angle formed to receive filler panel.

H. End Panels: Provide solid phenolic end panels designed for concealing fasteners and holes at exposed ends of nonrecessed lockers.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, and support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install level, plumb, and true; shim as required, using concealed shims.

1. Anchor locker runs at ends and at intervals recommended by manufacturer. Install anchors through backup reinforcing plates, channels, or blocking as required to prevent distortion, using concealed fasteners.
2. Anchor single rows of lockers to walls near top of lockers and to floor.

3. Anchor back-to-back lockers to floor.

B. Equipment and Accessories: Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.

3.3 ADJUSTING, CLEANING, AND PROTECTION

A. Clean, lubricate, and adjust hardware. Adjust doors and latches to operate easily without binding. Verify that integral locking devices operate properly. Protect lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit locker use during construction.

B. Touch up marred finishes, or replace lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION 10 51 13

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: This Section includes, but is not limited to, all materials, labor and equipment, complete with all anchors and related accessories, necessary to furnish, deliver and install:

1. Wire Shelving
2. Stainless Steel Wire Shelving

B. Although such work is not specifically shown or specified, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.

C. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 018113, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

1.3 DESIGN REQUIREMENTS:

A. Manufacturer is responsible for designing and sizing units to meet specified load requirements.

1.4 SUBMITTALS:

A. General: Submit in accordance with Division 1.

B. Product Data: Submit technical data and descriptive literature for each product.

C. Shop Drawings: Submit drawings indicating all layouts, types, spacing, and attachment details for the types of storage shelving specified herein.

D. LEED Submittals:

1. Recycled Content (MR4): Submit product data or other published information indicating total weight of product to be provided for the Project, percent of post-consumer recycled material by weight and percent of post-industrial recycled material by weight. Include material costs (excluding costs of installation).

1.5 COORDINATION

A. Coordinate with other sections of the specifications to insure that proper provisions are made for the installation of the work specified herein.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of Division 1.

1.7 WARRANTY

A. Comply with requirements of Division 1.

B. Provide lifetime warranty against corrosion and rust. Warrant units to be free from defects in material and workmanship for 5 years from date of purchase. Include coverage against defects that may arise during the warranty period except those which are caused by misuse.

PART 2 - PRODUCTS

2.1 WIRE SHELVING

A. MANUFACTURERS

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Metro Industries Corp., Wilkes-Barre, PA (Model Super Adjustable Erecta Shelving)
   b. Eagle MHC, Smyrna, DE
   c. Allen Company Fabricators, Minneapolis, MN

B. TYPE

1. Freestanding wire shelving system with open ends, open backs, fixed top and bottom shelves, and adjustable intermediate shelves.

C. FABRICATION

1. Shelves shall be Open Wire Design.
2. Intermediate shelves to be fully adjustable in 1” increments without use of tools.
3. Four (4) Stationary Posts. Post design with double grooves every 1" to provide a visual guide for positioning and adjusting shelves.
4. All components to be corrosion and rust-proof. Epoxy Coated Finish.
5. Units shall not require lateral cross-bracing.
6. All freestanding shelving shall be capable of being leveled at the base of the posts with leveling screws.
7. Unit shall comply with NSF Standards for use in all conditions.

D. FINISH

1. All metal shelving and components shall receive manufacturer's standard finish in color selected by the Architect.

2.2 STAINLESS STEEL WIRE SHELVING

A. MANUFACTURERS

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Metro Industries Corp., Wilkes-Barre, PA (Model Super Adjustable Erecta Shelving)
   b. Eagle MHC, Smyrna, DE
   c. Allen Company Fabricators, Minneapolis, MN

B. TYPE

1. Freestanding stainless steel wire shelving system with open ends, open backs, fixed top and bottom shelves, and adjustable intermediate shelves.

C. FABRICATION

1. Shelves shall be Open Wire Design.
2. Intermediate shelves to be fully adjustable in 1” increments without use of tools.
3. Four (4) Stationary Posts. Post design with double grooves every 1" to provide a visual guide for positioning and adjusting shelves.
4. All components to be stainless steel.
5. Units shall not require lateral cross-bracing.
6. All freestanding shelving shall be capable of being leveled at the base of the posts with leveling screws.
7. Unit shall comply with NSF Standards for use in all conditions.

D. FINISH

1. All stainless steel shelving and components shall by type 304 Stainless Steel with a No. 4 finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions and proceed with work in accordance with Division 1.

3.2 INSTALLATION

A. Install in accordance with Division 1, and approved shop drawings.

B. Assemble and install metal storage shelving at locations indicated on the drawings. Install all intermediate loose shelves at spacing indicated.

C. Level each unit to compensate for any floor irregularities. Posts shall be aligned with adjacent units and each post shall rest securely on the floor.

D. Protect storage shelving from defacement, scratching or other defects after installed and until final acceptance of the project. Do not allow other trades to store construction materials on shelving. Replace any damaged or defaced units prior to final inspection and acceptance of the project at no additional cost to the Owner.

END OF SECTION 105623

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: This Section includes, but is not limited to, all materials, labor and equipment, complete with all anchors and related accessories, necessary to furnish, deliver and install:

1. High Density Shelving System
2. Museum Type Adjustable Shelving Units

B. Although such work is not specifically shown or specified, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.

C. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 018113, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

D. Related Sections:

1. Section 115300 - Laboratory Equipment-General Requirements: Equipment schedule.
2. Division 26 - Electrical: Conduit and wiring to points of connection in junction box.

1.3 SYSTEM DESCRIPTION

A. Design Requirements:

1. Manufacturer is responsible for designing units, including anchorage of units to structural system and necessary modifications to meet specified requirements and maintain visual design concepts.
2. Drawings are diagrammatic and are intended to establish basic dimension of units, sight lines, and profiles of units.
3. Provide concealed fastening whenever possible.
4. Attachment considerations: Account for site peculiarities and expansion and contraction movements so there is no possibility of loosening, weakening and fracturing connection between piping and units.
5. Dimensions and utility connections are based on the items specified. Contractor is responsible for all costs for dimensional adjustments required as a result of using an equal product.
6. Equipment may be inspected by Owner at manufacturer's plant prior to shipment. Equipment found not in accord with specifications and approved Drawings may be rejected. Replace rejected equipment at no cost to Owner.

1.4 QUALITY ASSURANCE

A. Single Source Responsibility:

1. Furnish products for each type of shelving unit from one manufacturer for entire Project, unless otherwise acceptable to Architect.
2. Provide each product as complete unit, including accessory items necessary for proper operation.

B. Manufacturer Qualifications: Company specializing in manufacturing Products specified in this Section with minimum 5 years documented experience.

C. Installer Qualifications: Manufacturer, or approved in writing by manufacturer.

1.5 SUBMITTALS

A. General: Submit in accordance with Division 1.

B. Product Data:

1. Submit product data.
2. Include data to indicate equipment dimensions and construction, equipment capacities, and point loads.
3. Include information for factory finishes, hardware, glass, sealants, accessories, and other required components.
4. Include wiring diagrams and rough-in requirements.

C. Shop Drawings:

1. Indicate typical layout including sections and elevations with dimensions.
2. Submit detail drawings of materials, construction, anchorage devices, and finishes.

D. Samples:

1. Finishes.
2. Include color charts for finish indicating manufacturer's full range of colors available for selection.

E. Closeout Submittals:

1. Submit under provisions of Division 1.
2. Project record documents: Record actual locations of electrical components, and writing.
3. Operation and maintenance data.
4. Warranty: Submit specified warranty.

F. LEED Submittals:

1. Recycled Content (MR4): Submit product data or other published information indicating total weight of product to be provided for the Project, percent of post-consumer recycled material by weight and percent of post-industrial recycled material by weight. Include material costs (excluding costs of installation).

2. For Credit IEQ 4.3: Manufacturers' product data for paints, including printed statement of VOC content.

1.6 PRE-INSTALLATION CONFERENCE

A. Conduct pre-installation conference in accordance with Division 1.

B. Convene pre-installation conference one week prior to commencing work of this Section.

C. Attendance Required: Owner, Architect, Contractor, Manufacturer's Representative, and Installer.

D. Agenda: Discuss and agree upon acceptable substrate and support conditions, preparatory work, interface with mechanical and electrical services, and methods of installation and testing.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of Division 1.

B. Comply with instructions and recommendations of manufacturer for special delivery, storage and handling requirements.

C. Field Measurements: Verify shelving unit location by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.8 WARRANTY

A. Warrant installed compact shelving to be free from defects in material and workmanship for 5 years from date of substantial completion.

B. Include coverage against defects, which may arise during the warranty period except those which are caused by misuse.

1.9 MAINTENANCE

A. Service: Provide service and maintenance of compact shelving system and components for 12 months from date of Substantial Completion to maintain warranty conditions.

PART 2 - PRODUCTS

2.1 HIGH DENSITY SHELVING SYSTEM:

A. MANUFACTURERS

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Spacesaver, Fort Atkinson, WI
   b. Montel Inc., Satellite, FL
   c. MTM Business Systems, Tustin, CA

B. DESCRIPTION

1. Provide complete compact shelving system, mechanically assist type, of size and layout, as indicated on drawings. Provide stationary and mobile carriages as shown.
2. Clearances: Allow 2" minimum clearance from back wall and 18" minimum from ceiling (coordinate with sprinkler heads, smoke alarms, etc, protruding from ceiling).

3. Aisle widths: Add a minimum of 4" to the depth of shelving section to calculate carriage width (i.e. 20" deep shelving will require 24" of floor space.) To calculate the access aisle in front of system.

C. LEED Requirements:

1. Comply with requirements specified in Section 018113 “Sustainable Design Requirements & LEED Scorecard”.
2. Give preference to products with materials harvested/extracted/recovered and manufactured/milled within 500 miles of Project site.
3. Give preference to products containing renewable materials.
4. All field-applied paints and coatings used within the building waterproofing envelope shall comply with Section 090007 “Painting” and 090008 “Specialty Painting and Coatings.”

2.2 HIGH DENSITY SHELVING SYSTEM REQUIREMENTS

A. Rail/Track System:

1. Rails shall be designed and manufactured to carry a minimum load of 1,000 pounds per linear foot of carriages.
2. Rails shall exhibit no movement or deflection during operation of mobile ranges.
3. Rails shall be level with and not project above or below the walking surface.
4. Rails shall be designed to be attached on top of structural concrete floor and to allow for adjustment so rails can be leveled over an uneven floor.
5. Rails shall be a structural section of steel compatible with wheel design and carriage loads. This structural design shall disburse the concentrated wheel point loads.
6. The rail design shall incorporate smooth contact surfaces for the wheel/wheel guidance.
7. Maximum profile of recess adjacent to rail to accommodate manufacturer's carriage guidance system and/or anti-tip system 1-1/8" wide by 3/4" deep.
8. All rail connection joints shall be designed to provide horizontal and vertical continuity between rail sections, to gradually transfer the concentrated wheel point load to and from adjoining rail sections, and to absolutely prevent rail separation and rail delamination.
9. Rail shall be located and positioned properly, leveled and grouted, allowing at least 1/4" for grout under high point. Grout to be worked under rail, any voids completely filled and trimmed up sides flush with rails. This will allow proper weight distribution from rail to sub-floor. (Shims unacceptable.)
10. Levelness of rails: 3/32" maximum variation from true level within any module; 1/16" maximum variation between adjacent rails, perpendicular to rail direction; 1/32" maximum variation in 10'-0" of rail length, along any rail.
11. Rails to be rechecked for integrity of position and levelness and anchored into structural concrete slab, using anchors in sizes and quantities as determined by manufacturer.
12. Main rail section shall be a minimum of 6' each with shorter sections used only to terminate each individual rail assembly.

B. Grout Specifications:

1. General: The compound shall be a hydraulic type cement which, when mixed with water, will harden rapidly to produce a permanent bolt setting anchor. The compound shall conform to the following specifications, all of which are based on the performance of the test specimens at room temperature and in laboratory air:
2. Linear Movement: It shall not shrink on setting, but shall exhibit a slight expansion of not more than .002 inches per linear inch.
3. Compression Strength: Two inch cubes made in accordance with ASTM standards tested on a Balding-Southward machine of 60,000 pounds capacity shall have the following minimum average compression strengths:

Age: 1 hour ---- 4,500 psi
7 days ---- 5,000 psi

C. Floor/Ramp:

1. Rails: One-piece, low profile load rails of cold drawn structural steel with in-rail anti-tip grooves, shall provide uniform distribution of heavy loads and precision alignment for long term, easy carriage operation under heavy cyclic load stress. Rails to be top mounted and finished with fire treated plywood ramp and decking. One piece ramp sections of the same material shall be installed at the entrances to the system, recessed under the ends of the carriages, to provide a sloped surface between the existing floor and the system's raised plywood floor that does not extend into the aisle space in front of the system.

D. Carriages/Drive/Guide:

1. Carriages:
   a. All carriages are to be unit welded construction. Galvanized structural components unacceptable.
   b. Fixed carriages, as shown on the drawing, shall be of same construction and height as the movable carriages and anchored to rails.
   c. Necessary carriage splices shall be bolted type designed to maintain proper unit alignment and weight load distribution.
   d. Carriage straightness shall have no more than 1/4" maximum deviation from a true straight line. There shall be no permanent set or slippage in any spliced or welded joint when exposed to forces encountered in normal operating circumstances.
   e. Each carriage shall have two wheels per rail.

2. Drive/guide system:
   a. Drive/guide system shall absolutely prevent carriage whipping, binding, and wheel/rail wear under normal operation. Drive shafts shall be 1" minimum diameter. All connections between drive shafts shall be by means of secured connections. Drive shaft shall exhibit no play or looseness over the entire length of that assembly. All rotating load bearing members must ride in ball or roller bearings. All line shaft bearings shall be a pillow block or flange self-aligning type. Guidance system shall absolutely prevent carriage derailment. Shafts shall drive wheels or synchronized wheel assemblies, or as required.

3. Wheels:
   a. Wheels shall be constructed of solid steel for smooth operation. All bearings shall be permanently shielded and lubricated.
   b. All wheels shall be designed and manufactured to carry a minimum static and moving carriage load of 3,200 pounds each.

4. Finish:
   a. All metal components shall receive manufacturer's standard finish in color selected by the Architect. Carriages shall be painted the same color as the shelving.
   b. Finished exposed carriage faces shall have a smooth appearance.

E. System Operation:

1. The system shall be of the mechanical assist type. A driving system is required to provide uniform movement along the total length of the carriage even with unbalanced loads on

the carriage. The system shall be a positive drive to ensure that there is no play in the drive handle and that the carriage will stop without drifting.

2. All components of the system shall be compatible for smooth non-jerking, even movement along the total length of the carriage. Drive system shall have a minimum gear ratio requiring 1 pound of pressure to move a load of 6000 pounds. All bearings used in the drive mechanism shall be permanently shielded and lubricated.
3. Operating handles shall be three-spoke type with steel spokes (single spoke handles unacceptable), approximately 17” diameter, which transmit power to the drive wheels. Provide operating handles on drive end of carriages. Each mechanical device shall come with a chain-tensioning.

F. Safety Feature Requirements:

1. A minimum finger clearance of 1" must be maintained between all ranges including all shelving and end panels.
2. Neoprene bumpers extending a maximum of 1-1/2" from the face of carriage frames shall provide a safety space and a positive stop for all mobile carriages.
3. Each carriage shall be equipped with in-rail anti-tips as required to assure operator safety and prevent tipping of fully loaded unit.

G. Face Panels:

1. All exposed face panels, as shown on drawings, shall be high-pressure laminate. Finish to be selected by owner from standard line. Panels must cover full width and height of shelving/carriage.

H. Carriage Color:

1. Carriages shall be powder coat paint finished (1.5 mil. min.) inside and out. Color selected by owner to match cabinets. Powder coat paint finish is required for finish durability.

2.3 MUSEUM TYPE ADJUSTABLE SHELVING UNITS

A. MANUFACTURERS

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Lyon Workspace Products, Aurora, IL
   b. Montel Inc., Satellite, FL
   c. Viking Metal Cabinet Company, Bolingbrook, IL

B. Features
1. Box Post Uprights
   a. Knocked down construction
   b. All posts shall be punched on 1-1/2" centers to accept either clip attachment or bolt attachment.
   c. All components parts shall be welded to form a continuous upright assembly.
2. Shelf Clips
   a. Integration shelf clips shall be used. Four clips are required per shelf. Clips shall be one-piece construction.
3. Beams
   a. Heavy-duty 14-gauge steel beams
   b. Beam support clips shall bewelded to beam member.

c. Beam clips shall be 12-guage hot rolled steel. Clips shall have integral three prong fingers that allow for beams to be secured to post without additional hardware. Clips shall have integral fold in lock tab that can be bent in act as locking device prohibiting removal or dislodging of beam from post.
d. "Z" beam shall provide increased strength and load capacity and resist tipping

4. Shelves And Solid Decking
   a. Heavy Duty Wide Span Shelves 20-guage with front and rear “Box W” formation.
   b. The front and rear flanges of the shelf shall be punched to accept bin fronts, label holders, and other accessories.
   c. All corners are lapped and welded. All shelves are punched on 3" centers for divider attachment.
5. Sizes: As shown on drawings.
6. Load capacities: Up to 500 pounds per shelf.
7. Ribbed Decking

C. WARRANTY

1. Guarantee high density shelving system, cabinets and accessories from defects in material and workmanship for a period of five (5) years.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions and proceed with work in accordance with specifications.

B. Correct unsatisfactory conditions.

C. Start of work constitutes acceptance of responsibility for performance.

3.2 INSTALLATION

A. Install in accordance with manufacturer's printed instructions and approved shop drawings.

B. Follow manufacturer’s printed instructions or drawings in all cases where items or details are not indicated.

C. Except for final connection, installation of each item shall be complete in every respect.

1. Provide all controls, regulating devices and all other accessories necessary for proper operation and maintenance of compact shelving system.
2. Include all accessories whether or not they are specifically indicated.

D. Install compact shelving system plumb, level, square, and free from warp or twist while maintaining dimensional tolerances and alignment with surrounding construction and adjacent surfaces.

E. Repair or replace damaged, stained or rejected work.

F. Test and adjust all items of equipment for satisfactory operation.

3.3 ADJUSTING

A. Adjust parts for smooth, uniform operation.

3.4 CLEANING

A. Clean as required by manufacturer. Do not use materials and methods which may damage finish and surrounding construction.

3.5 DEMONSTRATION

A. Provide system demonstration at mutually agreed upon time to Owner.

3.6 PROTECTION

A. Protect finished work in accordance with Division 1.

END OF SECTION 105630

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Canopy sunshades (S-1) supported by steel structure.
2. Eggcrate sunshades (S-2) supported by curtain wall.
3. Interior aluminum light shelf.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 051200 - STRUCTURAL STEEL for support of sunshades.
2. Section 08 44 10 - GLAZED ALUMINUM CURTAIN WALLS for support of sunshades.

1.3 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of product indicated.

B. LEED Submittal:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of post-consumer and pre-consumer recycled content.

a. Include statement indicating costs for each product having recycled content.

2. Product Data for Credit MR 5: For products having regional materials, documentation indicating percentages of building materials and products that have been extracted, harvested or recovered, as well as manufactured, within 500 miles of the project site.

a. Include statement indicating costs for each product having regional materials.

C. Shop Drawings: For sun control systems. Include plans, elevations, sections, details, and attachments to other work.

1. Include structural analysis data signed and sealed by the qualified professional engineer registered in the jurisdiction where the Project is located responsible for their preparation.
2. Include details of attachment to aluminum framing systems.
3. Include details of provisions for system expansion and contraction and for draining moisture occurring within the system to the exterior.

D. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

E. Qualification Data: For Installer.

F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for sun control systems.

G. Maintenance Data: For sun control systems to include in maintenance manuals.

H. Warranties: Special warranties specified in this Section.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Capable of assuming engineering responsibility and performing work of this Section and who is acceptable to manufacturer.

1. Engineering Responsibility: Preparation of data for sun control systems including Shop Drawings based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project and submission of reports of tests performed on manufacturer's standard assemblies.

1.5 WARRANTY

A. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes fail within specified warranty period. Warranty does not include normal weathering.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Airline Products Co.
2. Airolite Co.
3. C/S Group.
4. Ruskin Manufacturing Co.

B. Basis-of-Design: C/S Group.

2.2 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

1. Sheet and Plate: ASTM B 209.
2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
3. Extruded Structural Pipe and Tubes: ASTM B 429.
4. Structural Profiles: ASTM B 308/B 308M.
5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.

B. Fasteners, Anchors and Inserts: Provide stainless steel or aluminum fasteners, anchors and inserts, as recommended by the manufacturer. Conceal from view to greatest extent possible. Finish exposed items to match sun control systems.

2.3 ACCESSORY MATERIALS

A. Joint Sealants: For installation at perimeter of systems, as specified in Section 07 92 00 - JOINT SEALANTS.

B. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil thickness per coat.

2.4 FABRICATION

A. Shop fabricate work to the greatest extent possible. Fabricate work to be truly straight, plumb, level and square. Maintain equal blade spacing from blade to blade and from blade to frame. Use welded connections wherever possible.

B. Form aluminum shapes before finishing.

C. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

2.5 ALUMINUM FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Fluoropolymer Two-Coat Finish System: Manufacturer's standard two-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color coat, with

topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight, with a minimum total dry film thickness of 1.5 mil; complying with AAMA 2605.

1. Color and Gloss: Match Valspar Fluoropon Classic II, Champagne Gold, Pearlescent/Mica Fleck Finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.

B. Metal Protection:

1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape or installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components plumb and true in alignment with established lines and grades, without warp or rack.

END OF SECTION 10 71 10

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Appliances.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Division 22 - PLUMBING for water distribution piping connections, drainage and vent piping connections, sinks, and waste disposers.
2. Division 26 - ELECTRICAL for services and connections to appliances.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include operating characteristics, dimensions of individual appliances, and finishes for each appliance.

B. Appliance Schedule: For appliances; use same designations indicated on Drawings.

C. Maintenance Data: For each product to include in maintenance manuals.

D. Warranties: Special warranties specified in this Section.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer for installation and maintenance of units required for this Project.

B. Source Limitations: Provide products from same manufacturer for each type of appliance required.

C. Regulatory Requirements: Comply with provisions of the following product certifications:

1. NFPA: Provide electrical appliances listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
2. UL and NEMA: Provide electrical components required as part of residential appliances that are listed and labeled by UL and that comply with applicable NEMA standards.
3. ANSI: Provide gas-burning appliances that comply with ANSI Z21 Series standards.

D. Regulatory Requirements, Accessibility: Where residential appliances are indicated to comply with accessibility requirements, comply with Massachusetts Architectural Access Board requirements and the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."

E. Energy Ratings: Provide residential appliances that carry labels indicating energy-cost analysis (estimated annual operating costs) and efficiency information as required by the FTC Appliance Labeling Rule.

1. Provide appliances that qualify for the EPA/DOE ENERGY STAR product labeling program.

F. Switches: Provide mercury-free switches in appliances.

G. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1.5 WARRANTY

A. Special Warranties: Manufacturer's standard form in which manufacturer of each appliance specified agrees to repair or replace residential appliances or components that fail in materials or workmanship within manufacturer's standard warranty period.

PART 2 - PRODUCTS

2.1 APPLIANCES

A. Appliance Schedule:

1. Refrigerator/freezers.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before equipment installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. General: Comply with manufacturer's written instructions.

B. Built-in Equipment: Securely anchor units to supporting cabinets or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and rough openings are completely concealed.

C. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.

D. Utilities: Refer to Division 22 - PLUMBING for plumbing requirements and Division 26 - ELECTRICAL for electrical requirements.

3.3 CLEANING AND PROTECTION

A. Test each item to verify proper operation. Make necessary adjustments.

B. Verify that accessories required have been furnished and installed.

C. Remove packing material from appliances and leave units in clean condition, ready for operation.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train the Owner’s maintenance personnel to adjust, operate, and maintain appliances.

END OF SECTION 11 31 00

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

1.2 DESCRIPTION OF WORK

A. The work of this Section consists of the provision of all plant, materials, labor and equipment and the like necessary and/or required for the complete execution of all audiovisual equipment and related work for this project as required by the schedules, keynotes and drawings, including, but not limited to the following:

1. Unless otherwise specified, supply only new equipment, parts and material, and protect all equipment from construction dust and debris until final acceptance. Operate only as required for testing as part of installation procedure. Provision of all manufactured components, installation, wiring, and testing is the responsibility of a single contractor.
2. The system drawings indicate the general layout of the various items of equipment and their functional relationships. However, layout of equipment, accessories, and conduit systems are diagrammatic unless specifically detailed and do not necessarily indicate every item required for a complete installation. Provide any incidental equipment needed in order to result in a complete and operable system even if not specified or shown on drawings without claim for additional payment.
3. Quantities of all major installed and all portable equipment, including any add- or deduct-alternates, are indicated on the syestem and electrical drawings. Quantities of portable equipment are indicated in schedules contained in the drawings or specifications; quantities of installed equipment are determined by examining the functional diagrams, plans, and riser diagrams.
4. Refer to audiovisual conduit drawings for receptacle backbox location and quantity information. Also refer to architectural reflected ceiling plans for exact location of ceiling-mounted devices.
5. Verify correctness of parts lists and equipment model numbers and conformance of each component with manufacturer's specifications.
6. Obtain all permits necessary for the execution of the work. Comply with all applicable local codes and regulations.
7. Supply and install miscellaneous steel, such as Unistrut, above finished ceiling for mounting each video projector.
8. Install Owner Supplied Computer identified on drawings.
9. All primary conduit and wireways as shown on the AV drawings are included in the General Contractor’s scope of work and are not to be provided in the Audiovisual Contract. Supply and install all miscellaneous conduit and wireways to the extent not included in Division 16 in order to provide a complete and operable system.
10. Millwork: Schematic details of the lectern and front wall console are included for the purpose of facilitating coordination of the installation of audiovisual components in these millwork items to be provided by the General Contractor.

B. Functional Requirements of Systems:
   1. Classrooms 210 and 220:
      a. Display of video on two screens using two ceiling-mounted video projectors and of audio using coaxial ceiling loudspeakers.
      b. Display of PC and MAC computers, document camera, standard and Blu-ray DVDs, cable television programming, and portable sources.
      c. Annotation over PC and MAC computer video using annotation monitor on teaching station.
      d. Speech reinforcement using gooseneck microphone on teaching station and wireless lavaliere microphone.
      e. Hearing assistance using infrared ADA system.
      f. Remote control of system functions using touchscreen control panel on teaching station.
   2. Teaching Labs 013, 019, 103, 127, 214, 221, 243, 325, & 345:
      a. Display of video using wall-mounted short-throw projector and of audio using loudspeakers in projector wall mount.
      b. Display of VGA and digital computer video from computers at the teaching station.
      c. Remote control of system functions using fixed wall-mounted control panel.
   3. Teaching Labs 124 & 211:
      a. Display of video using ceiling-mounted projector and of audio using wall-mounted loudspeakers.
      b. Display of VGA and digital computer video from computers at the teaching station.
      c. Remote control of system functions using fixed wall-mounted control panel.
   4. Conference Rooms 212 and 319
      a. Display of video using wall-mounted LCD display (70” in 212 & 80” in 319).
      b. Display of owner-provided computer (in credenza) and portable sources at table.
      c. Remote control of system functions using control panel in table box.
   5. Knuckle Lounge 024:
      a. Display of video using wall-mounted short-throw projector and of audio using loudspeakers in projector wall mount.
      b. Display of standard and Blu-ray DVDs, cable television programming, and portable sources at front of room or at equipment rack.
      c. Hearing assistance using infrared ADA system.
      d. Remote control of system functions using fixed wall-mounted control panel and wireless control panel.
   6. Lounge 048:
      a. Display of video using wall-mounted LCD display.
      b. Display of portable sources.
      c. Remote control of system functions using fixed wall-mounted control panel and wireless control panel.
   7. Corridor 026:
      a. Display of digital signage video and microscope video using wall-mounted LCD display.
      b. Remote control of system functions using fixed wall-mounted control panels in microscope rooms.
   8. Corridor 134:
      a. Display of digital signage video using wall-mounted LCD display.

C. Related Work Specified Elsewhere:
   1. Miscellaneous Metals (05500).
   2. Rough Carpentry (06100).
   3. Finish Carpentry (06200).
   4. Caulking and Sealing (07900).
   5. Glazing (08800).
   6. Furring, Lathing and Plastering (09200).

7. Gypsum Drywall (09250).
8. Projection Screens (11132).
9. Electrical Work including all power and grounding systems; conduit, raceway and cable tray systems; loudspeaker enclosures and floor boxes; cable TV drops (Division 16).

D. Definitions:
1. XLR Connectors and Receptacles: Connectors and receptacles conforming to proposed E.I.A. Standard RS-297-B referred to as "XLR"-type connectors and receptacles.
2. Units and Symbols: Metric units according to the System of International Units (SI) are used as well as other common units and symbols.
3. Octave and 1/3-Octave Bands: Centered on ANSI preferred frequencies.
4. Sound Level Meter and Filter Set: Calibrated ANSI Type 1 meter with ANSI S1.11-1966 1/3 octave band filters.
5. Pink Noise: Constant energy in constant percentage bands, random or quasi-random noise.
6. Loudspeaker Power Rating: Based on pink noise test signal with 6 dB peak-to-average ratio, bandwidth as stated.
7. Loudspeaker Coverage Pattern: Nominal angular coverage included at -6 dB points relative to axial response, bandwidth as stated.
8. DI: Axial directivity index.
9. Loudspeaker Sensitivity: Axial level in dB with 1 watt input at 1 meter distance.

E. Microphone Sensitivity: Level in dB re 1 milliwatt into rated impedance at 1000 Hz (or as otherwise stated) and 94 dB SPL. (10 dynes/cm` or 1 Pa).
1. SPL: Sound pressure level in dB re 0.00002 Pa (0.0002 microbar).
2. Power Amplifier Output Power Rating: Based on continuous average sine wave test signal. Load impedance and bandwidth as indicated.
3. Amplifiers and Signal Processors: Frequency Response, Distortion, and Hum and Noise re full rated output level.

1.3 BID SUBMITTALS

A. Instructions to Bidders: To be considered, Bids must be made in accord with the Architect's Instructions to Bidders and this Article.

B. Examinations: Carefully examine the contract documents and the construction site to obtain first-hand knowledge of existing conditions. Contractors will not be given extra payments for conditions that can be determined by examining documents or site and will not be relieved of any obligations with respect to bid.

C. Questions: Submit all questions about the contract documents in writing. Replies requiring changes to the contract documents will be issued to all bidders as addenda and will become part of the Contract. The Architect and Owner may give but will not be responsible for oral clarifications. Questions received less than 10 days before bid date cannot be answered in writing.

D. Acceptable Products: Model numbers and manufacturers identified herein indicate a standard of quality and performance. Other products will be considered subject to approval of complete technical data, samples and results of independent testing of proposed equipment, submitted in accordance with Division 1 requirements and “Substitutions” section below.

E. Substitutions: To obtain approval for substitutions and for items identified as "approved equal", submit written requests at least 10 days before bid date. Requests received after this time will not be considered. Requests shall clearly describe the product for which approval is asked, including all data necessary to demonstrate acceptability. If the product is acceptable, an Addendum may be issued to all bidders.

F. Equipment Availability: Verify with manufacturers availability and cost of all equipment proposed, including equipment specified herein. No cost increases will be allowed for

manufacturers' cost increases, or for substitutions required because of unavailability of proposed equipment.

G. Performance Bond: The successful bidder will furnish a Performance Payment Bond and Labor and Material Bond, underwritten by a surety company approved by the Architect and Owner, for fulfillment of all provisions of the contract.

H. Basis of Bids:
1. Include a complete itemized list for each base-bid system indicating the manufacturer, model number, unit cost and total costs for all specified items. Itemization of miscellaneous equipment such as cable, switches, and receptacles is not required. Equipment listed in the bid submittal that is one of the acceptable products listed in the specification will be released for immediate order placement upon award of the contract, with no formal submittal process. Submissions for non-specified products may be included with the bid submittal for possible approval for order upon contract award.
2. Itemize actual contractor cost of all major equipment items. Owner has special pricing arrangements with equipment manufacturers, such as Crestron and Panasonic. Where possible, obtain Boston University pricing for such equipment. Where submitted contractor pricing exceeds Boston University pricing, Owner may arrange for contractor to purchase equipment at the BU pricing; in which case the contract price will be adjusted downward accordingly.
3. Clearly indicate the total cost, including all expenses, for each individual system to allow the Owner to select any or all to be included in the contract. Itemization of miscellaneous equipment such as cable, switches, and receptacles is not required.
4. Organize each list with the information presented, in the order that it appears in this specification, in 6 columns from left to right:
   a. Paragraph number as it appears in this specification.
   b. Paragraph title as it appears in this specification.
   c. Manufacturer and model number.
   d. Quantity.
   e. Unit Cost.
   f. Extension (unit cost times quantity).
5. At the end of each list indicate the cost of all other items such as for miscellaneous equipment, engineering, installation labor, overhead, taxes, etc.
6. On a separate list indicate costs of specified Deduct-Alternates A through F with the information presented in the same manner as for the base-bid system.
7. Include a listing of any voluntary alternates proposed by the bidder as substitutions or additions to the specified systems.
8. Include any notes or comments if necessary to qualify the bid.
9. Identify any sub-contractors and indicate the work they are to do.
10. Provide documentation of ability in installing similar systems. Furnish the names, addresses and telephone numbers of the System Designer, Architect, General Contractor and Owner on three projects similar in scope, which the Contractor has installed within the last 5 years.
11. Include certification of ownership and full familiarity with the operation of the following minimum test equipment. Provide a list of the manufacturer, model, and serial number for each item of test equipment required.
    a. Low distortion sine wave oscillator.
    b. Distortion analyzer.
    c. AC impedance bridge.
    d. Oscilloscope.
    e. Sound level meter, 1/3 octave band real time audio analyzer and pink noise generator.
    f. Multimeter.
    g. Cable Tester (suggested: Sescom CT-1A).
    h. Video waveform monitor, vectorscope, and signal generator.

i. Photometer with luminance and illuminance probes.
j. ½" type H (VHS) format videocassette test tape: SMPTE V2-RMS-V.
k. Multi-frequency computer RGB test pattern generator (suggested: Extron VTG-300 or VTG-400DVI).
l. HDMI test pattern generator (suggested: TV One 1T-TG-620 HDMI Pattern Generator or Gefen TV 1080p signal generator for HDMI with adapters to DVI and DisplayPort).

1.4 QUALITY ASSURANCE

A. Project Management: Maintain the same person in charge of work throughout installation.

B. Contract Documents: Maintain a complete set of system drawings and specifications at the site at all times during installation.

C. Fabrication and Installation: Fabricate all equipment racks and subassemblies. Make field connections of all audio, video and control wiring including microphone, line level, loudspeaker, video, and control system circuits to equipment, equipment racks and connection panels. Continuously supervise the installation and connections of cable and equipment.

D. Contractor Qualifications: To be considered qualified for this work, the contracting firm must be experienced in the provision of audiovisual systems similar in complexity to those required for this project, and meet the following:
1. The Contractor's primary business is the provision, fabrication and installation of professional audiovisual and related systems.
2. The Contractor has been regularly engaged in the installation and service of professional audiovisual presentation systems for a period of at least five years.
3. The Contractor is an authorized dealer for the major products furnished.
4. The Contractor is an authorized dealer for the specified Audiovisual Control System and factory trained in the installation, maintenance and programming of such systems.
5. At the request of the Architect demonstrate the following capabilities:
a. Adequate plant and equipment to complete the work.
b. Sufficient staff with appropriate technical experience to oversee and execute the work.

E. Subcontractors: The Contractor may arrange for sub-contract field and special shop work to be done by others.

F. Prime Contractors: Any other installer who intends to bid on this work as the Prime Contractor and does not meet the "Contractor Qualifications" described above shall employ the services of a single "Audiovisual Systems Contractor" who does meet these requirements. The Audiovisual System Contractor shall Furnish and Install the equipment. The Prime Contractor shall clearly identify the Audiovisual Systems Contractor and submit complete qualification information for the Audiovisual Systems Contractor in the Bid. Failure to do so will be cause for rejection of the Bid.

1.5 SUBSTITUTIONS

A. General: The Contractor has the burden of proving, at the Contractor's own cost and expense and to the satisfaction of the Architect, that the proposed product is similar and equal to the named product.

B. Basis:
1. Requests for acceptance of proposed equivalents made following the award of bid will be considered by the Architect only in the following cases:
a. The named products cannot be obtained by the Contractor because of strikes, lockouts, bankruptcies or discontinuance of manufacturer and the Contractor makes a written request to the Architect for consideration of the proposed equivalent.

b. The proposed equivalent, in the opinion of the Architect, is equal or superior to the named product and its use is to the advantage of the Owner.

2. A formal request must be made for the substitution documenting fully the above reason. Include complete data on the proposed substitution substantiating compliance with the Contract Documents including product identification and description, performance and test data, references and samples where applicable, and an itemized comparison of the proposed substitution with the products specified or named by Addenda, with data relating to Contract time schedule, design and artistic effect where applicable, and its relationship to separate contracts. Accompany the request by accurate installed cost data on the proposed substitution in comparison with the product specified.

C. Consideration:

1. A request for substitution is a representation by the Contractor that:

a. The Contractor has personally investigated the proposed substitution and determined that it is equal or superior in all respects to that specified.

b. The Contractor will provide the same warranty for the substitution that would be for that specified.

c. The cost data presented are complete and include all related costs under this Contract, but exclude costs under separate contracts and exclude Architect's re-design costs, and that the Contractor waives all claims for additional costs related to the substitution which subsequently become apparent.

d. Indicate if there will be any cost impact on work by other trades.

e. The Contractor will coordinate the installation of the accepted substitute, making such changes as may be required for the Work to be complete in all respects.

2. An accepted substitution will be documented by Change Order modifying the Specifications. The Contract Price will be changed only if the substitution results in cost savings to the Owner.

1.6 SUBMITTALS

A. Coordinate all submittals with requirements set forth in Section 01300.

B. LEED Submittal:

1. Product Data for Credit MR 4: Indicating percentages by weight of postconsumer and preconsumer recycled content for products having recycled content. Include statement indicating costs for each product having recycled content.

2. For Credit IEQ 4.2: Manufacturers' product data for paints, including printed statement of VOC content.

C. Shop Drawings and Product Data:

1. The following is required for approval, prior to ordering product, fabrication and installation. Provide three (3) copies unless otherwise specified. Submit complete and at one time. Isolated items will not be considered for approval, except by prior authorization. Rejected items and items requiring correction must be resubmitted at one time, except by prior authorization.

2. The diagrams and details included with these specifications, modified to reflect the stated requirements and to reflect the details of the system as awarded, and including all additional required information, may be used in preparing shop drawings. Drawings that are submitted without the necessary modifications will be rejected.

3. All drawings shall be drawn on a computer-aided drafting (CAD) system.

a. Bill of Materials and Catalog Data Sheets of all manufactured items. At the end of the Bill of Materials include Catalog Data Sheets ("cut" sheets) for all product arranged in the order listed in the specifications and in the Bill of Materials. Submit in bound form using a 3-ring, GBC or similar binding, and including a cover page identifying the project and submittal. Organize the Bill of Materials with the information presented in the order that it appears in this specification, in 6 columns from left to right:

1) Paragraph number as it appears in this specification.
2) Paragraph title as it appears in this specification.
3) Manufacturer.
4) Model number.
5) Quantity.
6) Comments (if any are needed).

b. Block diagrams indicating proposed connections of all equipment and indicating equipment types and model numbers.
c. Equipment/projection/control room layout(s), and equipment rack and cabinet details.
d. Video Projectors: Provide plan and section drawings verifying image width, lens-to-screen distances and mounting methods. Provide detailed drawings of custom-fabricated or stock mounts and hardware.
e. Video camera, video monitor, and loudspeaker mounting arrangements.
f. Shop drawings of any unit, such as control panels, switch panels, or loudspeaker enclosures or grilles, to be fabricated or modified.
g. Programming instructions for specified Programming Service Company or for AV control system manufacturer if programming is specified to be done by Manufacturer.
h. Logic and detailed control panel layouts prepared by specified Programming Service Company. Provide page graphics (including text, buttons, colors, images, backgrounds etc.), as well as page flips, sub-pages and overall page logic flow.
i. Submittals as required by specifications.
j. Others as required by Architect or Consultant.

D. Samples:
1. Finish for control panels, racks, cabinets, and loudspeaker grilles.
2. Mechanical connectors for use in wiring.

E. Test Reports: Upon completion of SYSTEM PERFORMANCE TESTS AND ADJUSTMENTS specified in PART 3 - EXECUTION, submit for approval in writing test results including numerical values for all measurements. Also submit written certification that the installation conforms to specifications, is complete and operable, and is ready for FINAL ADJUSTMENTS AND ACCEPTANCE TESTS specified in PART 3 - EXECUTION. Provide three (3) copies unless otherwise specified.

F. Operation and Maintenance Data - Coordinate with Section 01700
1. Draft Copies: At time of FINAL ADJUSTMENTS AND ACCEPTANCE TESTS specified in PART 3 - EXECUTION, provide draft copies of all specified diagrams, schedules and manuals for inspection during demonstration and acceptance testing. Submit final copies thereafter. All drawings shall be drawn on a computer-aided drafting (CAD) system. For Contractor-prepared drawings, schedules and instructions, provide three (3) draft copies, one (1) final copy for specified mounting, and two (2) final copies for inclusion in specified Complete Instruction and Maintenance Manual, unless a different quantity is otherwise specified.
2. Functional Diagrams: Simplified single line block diagram showing interconnection of all major equipment components and functional relationships. Illustrate all receptacles, patch panel jacks, attenuators, transformers, switches, and loudspeakers. Key each patch panel jack to the patch bay by row and jack number. Diagram shall not illustrate terminal or interconnection cable number designations The Functional Diagram included with these specifications, modified to exclude details, transformer tap designations, etc., and to provide the information described above and any as-built changes, is suitable for this purpose. Complete on a single sheet of minimum size 24" by 36". Mount one photographic, wash-off mylar or rag paper photocopy print of each system behind acrylic at locations to be determined.
3. As-Built Diagrams:

a. The intent of the diagrams is to provide sufficiently clear and complete information that a technician of average skill may efficiently troubleshoot and service the system, even if unfamiliar with the installation.
b. Provide drawings showing all terminal blocks, connectors, relays, switches, transformers, attenuators, equipment components, and wires. Label all devices with manufacturer, model number, and reference number (e.g. "SW 15", "TB 6"); reference numbers shall be consistent across all drawings with no repetitions. As a minimum, provide an expanded version of the functional diagrams with cables fanned out at termination points and all labeling as specified above; provide additional drawings where system complexity does not permit complete information to be shown legibly on an individual sheet no larger than the project sheet size. Provide labels for cables continued onto another drawing, indicating termination device, terminal numbers, and drawing sheet on which the termination is shown.
c. Provide layout drawings of panels and other custom assemblies containing switches, relays, terminal blocks, receptacles, etc., using reference numbers to identify physical locations of devices or label devices with reference numbers in a location visible while viewing cable terminations. On wiring diagrams, label all conductors within cables for insulation color or other identifier. Label connectors, barrier strips, switches, relay sockets, etc., for terminal number. If device does not provide terminal designations, provide key diagram for reference.

4. Receptacle Location Plan: Plan of area showing locations and designations of all receptacles.
5. Serial Numbers: List of serial numbers for all equipment provided as part of design.
6. Control Setting Schedule: Fully document the settings of all non-user-adjustable controls. This includes power amplifier gain controls, equalizer settings, etc.
7. Complete Instruction and Maintenance Manual: Prepare in the form of an instructional manual for use by Owner's personnel. Provide one (1) draft copy and two (2) final copies unless otherwise specified.
8. Format:
   a. Size: 8-1/2" x 11", 20 lb. minimum weight white paper for typed pages, either manufacturer's printed data, or neatly typewritten. Provide one set of CDs with PDF versions of this information.
   b. Drawings: Provide reinforced punched binder tab, bind in with text. Fold larger drawings to size of text pages. Clear plastic "binding tape" (not "Scotch" tape) applied to edge of sheet and then punched is acceptable.
   c. Single-sheet product literature and contractor-prepared pages: Provide reinforced punched binder tab. Clear plastic "binding tape" (not "Scotch" tape) applied to edge of page and then punched is acceptable.
   d. Provide indexed tabs and flyleaf for each separate product, or each piece of operating equipment. Include typed description of product, and major component parts of equipment.
   e. Cover: Identify each volume with typed or printed title "OPERATING AND MAINTENANCE INSTRUCTIONS".
   f. Binders:
   g. Commercial quality three-ring binders with durable and cleanable plastic covers, 1" minimum, 2" maximum ring size.
   h. When multiple binders are used, collate the data into related consistent groupings.

9. Content of Manuals:
   a. Neatly typewritten table of contents for each volume, arranged in systematic order. Identify each product by product name and other identifying symbols as set forth in Contract Documents.
   b. Contractor, name of responsible principal, address and telephone number.
   c. Certificate of Warranty for the system as a whole as well as copies of the manufacturer's warranty for each equipment item.
   d. Service Contract. Include a preliminary schedule for the specified semi-annual site visits.
   e. Complete as-built diagrams for systems.
   f. Functional Diagram.
   g. Receptacle Location Plan.
   h. List of equiopment serial numbers.
   i. Original copies, high-quality laser printer printouts of PDF files, or high-quality photocopies of manufacturers' installation, operation, and service manuals, including schematic diagrams for each equipment item.
   j. Shop drawings of all custom-fabricated items.
   k. Control Setting Schedule.
   l. Audiovisual Control System:
      1) Color printouts of touch screens control panel graphic layouts, as installed.
      2) Listing of system brand, models and all associated peripherals.
      3) CD-ROM containing the master program for the system, the touch screen display program (including all macros) and all programming, communication, or other project-specific software required for re-programming.
   m. Software for Programmable Devices: Where a computer has been used in programming system components, provide CD-ROM and/or floppy disks containing the software, and instructions for making interconnections to the programmed devices for the purpose of modifying the programming.

G. If requested, available computer-drawn (CAD) bid drawings are provided in .DWG or DXF compatible format to assist the contractor in producing the required submittal and shop drawings. Upon request, bid drawings will be posted on Acentech's FTP site at http://ftp.acentech.com. Requests must include the project name, project number, drawing numbers and type of files requested. Requests should be forwarded to:

R. L. Philbrick, Jr.
Acentech Incorporated
33 Moulton Street
Cambridge, MA 02138
Tel: 617-499-8000, Fax: (617) 499-8074

1.7 JOB CONDITIONS

A. Sequencing and Scheduling:
   1. Coordinate work with adjacent work of other trades to facilitate construction and prevent conflicts.
   2. Afford other trades reasonable opportunity for installation of work and for the storage of materials.
   3. Staff the job to keep pace with the other Trades; otherwise, the Architect will require an increase in force or overtime work without additional expenses to the Owner.
   4. Abide by the decision of the Architect in case of conflict or interference by other trades.
   5. Refuse: Remove all refuse from the job site to the satisfaction of the Architect and Owner.

B. Insurances on the work of this specialty trade shall be provided as specified in Section 00810.

1.8 WARRANTY

A. Warrant all equipment to be free of faulty workmanship and defects, and from damage due to contamination by construction dust and debris for a minimum period of one year from date of final acceptance.

B. Emergency service: Within 24 hours of notification, restore the system to operation, replacing defective materials and repairing faulty workmanship. Make temporary repairs and provide loaner equipment at no charge if defective materials cannot be permanently replaced or repaired within this 24 hour time period. Due to the difficulty of scheduling access to heavily-used classrooms, provide emergency service between the hours of 7:00 am to 9:00 pm weekdays and 9:00 am to 5:00 pm on Saturdays without additional overtime charges.

C. Paint and exterior finishes, fuses, lamps, projection lamps, and video picture tubes excluded from above warranties except when damage or failure results from defective materials or workmanship covered by warranty.

D. The minimum warranty provisions specified above shall not diminish the terms of individual equipment manufacturers' warranties.

1.9 SERVICE CONTRACT

A. Provide a one-year service contract to commence after acceptance of installation without additional cost. Service to include two semi-annual visits to the site for routine adjustment and maintenance of all equipment. Provide a preliminary schedule for the semiannual visits.

B. Towards the end of each year's Service Contract, provide the owner with a proposal for continued service during the next year.

1.10 TRAINING

A. The Owner may assign personnel to participate with the contractor during installation. Without delaying the work, familiarize the Owner's personnel with the installation, equipment, and maintenance.

B. During tests and adjustments, permit the Owner's personnel to observe. When feasible explain the significance of each test.

C. Provide sufficient training to personnel selected by the Owner on operation and basic maintenance of all systems and equipment. Explain operation of control systems, set-up and operation of individual pieces of equipment and functions of overall systems.

D. Separate from the bid response quotation, provide an hourly cost for additional training.

1.11 INSPECTION

A. Notify the Architect of any defects in work by other trades affecting installation.

PART 2 - PRODUCTS

2.1 MICROPHONES AND ACCESSORIES

A. General:
   1. Sensitivity -55 to -65 dB unless otherwise stated.
   2. Outputs of all microphones 150-200 ohms nominal impedance, floating with respect to ground.
   3. All captive microphone cables terminated with male gender 3-pin "XLR"-type connectors such as Cannon XLR-3-12C, Neutrik NC-3MC, or Switchcraft A3M. All other microphone cables terminated with mating connectors.

B. Gooseneck Lectern Microphone:
   1. Subminiature condenser microphone transducer mounted on flexible gooseneck with shock-isolated mounting base and removable windscreen. Matte-black finish, with 18" overall length. Gooseneck flexible at top and bottom, with rigid center section. 9 to 52 VDC phantom power requirement.
   2. Acceptable Products:
      a. Audio-Technica AT857AMLa with AT8416 shock mount.
      b. Countryman Isomax M4HP5VS18EB with 1" windscreen.
      c. Shure MX418/C with preamp, shock mount and windscreen.

C. UHF Wireless Microphone System (Classrooms):
   1. General:
      a. UHF true diversity dual receiver system with lavalier/beltpack and handheld microphones on separate frequencies.
   2. Receiver:
      a. AC powered receiver with multi-function LCD display indicating group/channel setting, frequency, user name, squelch setting and menu “lock out” function
      b. Compander circuitry to increase dynamic range and signal-to-noise ratio.
      c. True diversity antenna system for reducing multipath problems.
      d. Multi-segment LED indicators for RF signal strength and audio level monitoring.
      e. 3-segment LED display for transmitter battery strength monitoring.
      f. 191 user-assignable frequencies.
      g. Balanced microphone and line-level output connectors on rear panel.
      h. Minimum Overall Performance Requirements:
         1) Frequency Response: 50-l5,000 Hz, ± 2 dB (without mic).
         2) Working Range: 500 ft (150m), minimum.
         3) Dynamic Range: 102 dB, A-weighted.
         4) RF Carrier Frequency: 782 to 806 MHz (USA) or 774 to 862 MHz (foreign).
      i. Acceptable Products:
         1) Shure ULXS4 diversity receiver.
   3. Body-Pack Transmitter:
      a. Body-pack type powered by 9 VDC battery.
      b. Built-in 5-segment LED battery strength display.
      c. Compander circuitry to match receiver.
      d. Selection of electret or dynamic microphone input.
      e. Power Output: 50mW RF.
      f. Acceptable Products:
         1) Shure ULX1.
   4. Lavalier Microphone:
      a. Miniature lavalier (lapel) microphone
      b. Acceptable Products:
         1) Shure WL185 cardioid lavalier microphone.
   5. Dual-Channel System:
      a. As above, sold as a package.
      b. Acceptable Products:
         1) Shure ULXP24D/87 with two (2) ULX1/WL185 beltpack transmitters/microphones.

2.2 AUDIO CONTROL AND PROCESSING EQUIPMENT

A. 2-Channel Power Amplifier:
1. Stereo volume control with volume up/down control via contact closures.
2. Acceptable Products:
a. Radio Design Labs RU-VCA2D.
b. Extron MPA 152.
c. Approved equal.

B. Assisted Listening System (ALS):
1. General:
a. Locate antenna for ALS no farther than 200 feet from transmitter.
b. Coordinate location of antenna with Owner, Architect, and Electrical Contractor.
2. Base Station Transmitter:
a. Features:
1) Operates on 216MHz.
2) LED indicators for audio level, RF modulation, and RF output power.
3) Tunable to 57 wide and narrow band channels.
b. Minimum Performance Requirements:
1) RF Frequency Range: 216.05-216.975MHz.
2) Transmitter Stability: 50PPM.
3) Output Power: 100mW.
4) Signal to Noise: 44dB.
c. Acceptable Products:
1) Listen Technologies LT-800 216 MHz base unit with:
a) Power supply.
b) Rack mount kit.
c) LA-104 Antenna (Remove antenna from base plate and mount on standard gang plate).
3. Receiver:
a. Features:
1) Field tunable with select channel up and down buttons.
2) Three stage battery indicator.
3) LED display of RF signal strength.
b. Minimum Performance Requirements.
1) RF Frequency Rang: 216.026-216975MHz.
2) Sensitivity: 6uV typical, 1uV maximum for 12dB SINAD.
3) Signal to Noise: 44dB.
c. Acceptable Products:
1) Listen Technologies LR-400-216 with:
a) LA-161 single ear bud.
4. Charger:
a. Features:
1) Fours slots master charging tray.
b. Acceptable Products:
1) Listen Technologies LA-301

2.3 LOUDSPEAKER EQUIPMENT

A. Playback Loudspeaker:
1. Two-way studio monitor unit containing separate low- and high-frequency loudspeakers and cross-over network.
2. Minimum Performance Requirements:
a. Frequency Response: 85-22,000 Hz, ± 5 dB.
b. Nominal Impedance: 8 ohms.
c. Sensitivity: 86 dB 1W/1m.
d. Power Handling Capacity: 50 watts continuous program.

3. Acceptable Products:
   a. JBL Control 25.
   b. Approved equal.

B. Coaxial Ceiling Loudspeaker:
1. Two-way loudspeaker with separate coaxially mounted woofer and tweeter drivers. With attached multi-tap 70 volt line matching transformer, back box and grille. Back box steel coated with damping compound. Grille at least 20% open.
2. Transformer Power taps 60,30,15,7.5
3. Acceptable Products:
   a. JBL Control 26CT.
   b. Approved equal.

2.4 CONTROL EQUIPMENT

A. Audiovisual Control System (Conference/Seminar Rooms):
1. General: Digital control system for AV devices.
   a. Programmable with high level language via external IBM-compatible or Macintosh computer (computer not provided.)
   b. Listing below indicates the basis of the system. The contractor is responsible to review this configuration and supply all programming and any additional components required to make a fully-functional system.
2. Features:
   a. Control inputs/outputs: IR/serial (x8), logic in/out (x4), relay out (x4), RS-232 (x5), Cresnet bus.
   b. Ethernet interface.
3. Acceptable Products:
   a. Crestron 2-Series System with the following components:
      1) MC2E control system.
      2) C2N-FTB-D table box with control panel (provide pull-out cables & engraved buttons as required)..
      3) As required: Power supplies and CNSP-XX control cables as required.

B. Audiovisual Switcher/Control System (Classrooms):
1. General: Digital receiver supporting a single display device with video and control.
   a. Programmable with high level language via external IBM-compatible or Macintosh computer (computer not provided.)
   b. Listing below indicates the basis of the system. The contractor is responsible to review this configuration and supply all programming and any additional components required to make a fully-functional system.
2. Features:
   a. Compatible with Crestron DigitalMedia system using UTP data cabling.
   b. Video Inputs: Computer (VGA/DisplayPort with monitor output), Presentation (VGA/HDMI) – 2 ea., and Transport (composite/S-Video/component/HDMI with S/PDIF audio) – 2 ea., DigitalMedia input – 2 ea.
   c. Audio Inputs: Six, balanced/unbalanced stereo line level analog inputs. Four inputs for wired microphones with phantom power. Digital bus for up to 8 additional microphone inputs.
   d. Video Outputs: Two HDMI and two DigitalMedia outputs.
   e. Audio Outputs: Stereo power amplifier20 watts/channel into 8 ohms; three stereo line level outputs.
   f. PC KVM extension using USB HID.
   g. Control inputs/outputs: IR/serial (x4), IR in, logic in (x4), relay out (x4), RS-232 (x2), Cresnet bus.
3. Acceptable Products:
   a. Crestron 2-Series System with the following components:
      1) Crestron DMPS-300-C DigitalMedia switcher/control system.

2) TPS-6 touchscreen control panel with SMK-6X swivel mount.
3) As required: Power supplies and CNSP-XX control cables as required.

C. Audiovisual Switcher/Control System (Knuckle Lounge 024):
1. General: Digital receiver supporting a single display device with video and control.
a. Programmable with high level language via external IBM-compatible or Macintosh computer (computer not provided.)
b. Listing below indicates the basis of the system. The contractor is responsible to review this configuration and supply all programming and any additional components required to make a fully-functional system.
2. Features:
a. Compatible with Crestron DigitalMedia system using UTP data cabling.
b. Video Inputs: Computer (VGA/DisplayPort with monitor output), Presentation (VGA/HDMI) – 2 ea., and Transport (composite/S-Video/component/HDMI with S/PDIF audio) – 2 ea., DigitalMedia input – 2 ea.
c. Audio Inputs: Six, balanced/unbalanced stereo line level analog inputs. Four inputs for wired microphones with phantom power. Digital bus for up to 8 additional microphone inputs.
d. Video Outputs: Two HDMI and two DigitalMedia outputs.
e. Audio Outputs: Stereo power amplifier20 watts/channel into 8 ohms; three stereo line level outputs.
f. PC KVM extension using USB HID.
g. Control inputs/outputs: IR/serial (x4), IR in, logic in (x4), relay out (x4), RS-232 (x2), Cresnet bus.
3. Acceptable Products:
a. Crestron 2-Series System with the following components:
1) Crestron DMPS-300-C DigitalMedia switcher/control system.
2) TPS-6X wireless touchscreen control panel.
3) CEN-HPRFGW wireless gateway.
4) MP-B20 button control panel..
5) As required: Power supplies and CNSP-XX control cables as required.

D. Audiovisual Control System (Lounge 048 and Teaching & Computer Labs):
1. General:
a. Fully integrated, programmable system for control of audiovisual equipment and other motorized, electronic or electrical devices that can be remote controlled.
b. Supports 4-wire control network operation for interfacing with outboard, remote devices including control modules and control panels.
c. Support for 8-wire LAN/Ethernet expansion of the control network.
d. Listing below indicates the basis of the system. The contractor is responsible to review this configuration and supply all programming and any additional components required to make a fully-functional system.
2. Acceptable Products:
a. Crestron 2-Series System with the following components:
1) MPC-M10-B-T AV Controller.
2) As required: power supplies, labels, and CNSP-XX control cables.

E. Audiovisual Control System (Corridor 026):
   1. General:
      a. Fully integrated, programmable system for control of audiovisual equipment and other motorized, electronic or electrical devices that can be remote controlled.
      b. Supports 4-wire control network operation for interfacing with outboard, remote devices including control modules and control panels.
      c. Support for 8-wire LAN/Ethernet expansion of the control network.
      d. Listing below indicates the basis of the system. The contractor is responsible to review this configuration and supply all programming and any additional components required to make a fully-functional system.
   2. Acceptable Products:
      a. Crestron 2-Series System with the following components:
         1) MPC-M5 Controller (2 required).
         2) As required: power supplies, labels, and CNSP-XX control cables.

F. Uninterruptible Power Supply (UPS):
   1. Computer-type power supply with instantaneous battery backup.
   2. Capacity: 300 VA/175 watts.
   3. Runtime: 10-15 minutes.
   4. Acceptable Products:
      a. APC BackUPS LS 350.
      b. Tripp-Lite BC Personal 300.
      c. Approved equal.

G. USB Switch:
   1. 4-input USB matrix switcher to support switching of up to four USB devices to up to four computers. Provided with host and peripheral emulation.
   2. Compatible with USB 2.0 standard.
   3. Remote control using RS-232.
   4. Acceptable Products:
      a. Extron SW4 USB Plus.
      b. Approved equal.

H. Annotation Monitor:
   1. Wide-screen LCD monitor with touch sensitive overlay which permits annotation over computer applications, written notes and drawings to be saved to a computer file, and control of supported applications. HDCP compliant. Support software included. Lectern mount.
   2. Acceptable Products:
      a. Smart Technologies 18.5” 500 Series SMART Podium.
      b. Approved equal.

I. Wireless Keyboard and Mouse:
   1. Wireless keyboard with mouse using Bluetooth RF transmission with a range of 60 feet. Includes Bluetooth receiver and mouse charge stand.
   2. Acceptable Products:
      a. Logitech MX 5000 Laser keyboard/mouse.
      b. Approved equal.

2.5 DIGITALMEDIA EQUIPMENT

A. HDMI DigitalMedia Transmitter (Conference/Seminar Rooms):
   1. General: Allows HDMI/DisplayPort/DVI-D and VGA signals to be transmitted using Digital/Media transport.
   2. Features:
      a. Transmits uncompressed digital video and audio over UTP/STP data cabling.
      b. Supports video resolutions up to WUXGA 1920x1200 and HD 1080p60 Deep Color.

c. Supports 100' cable runs at 1080p 60Hz Deep Color using Crestron DigitalMedia cable.
d. Includes USB HID keyboard/mouse support.
e. HDCP support and CEC device control.

3. Acceptable Products:
a. Crestron DM-TX-200.

B. HDMI DigitalMedia Transmitter (Classrooms):
1. General: Allows HDMI/DisplayPort/DVI-D and VGA signals to be transmitted using Digital/Media transport.
2. Features:
a. Transmits uncompressed digital video and audio over UTP/STP data cabling.
b. Supports video resolutions up to WUXGA 1920x1200 and HD 1080p60 Deep Color.
c. Supports 100' cable runs at 1080p 60Hz Deep Color using Crestron DigitalMedia cable.
d. Includes USB HID keyboard/mouse support.
e. HDCP support and CEC device control.
3. Acceptable Products:
a. Crestron DM-TX-201-C.

C. Wall-Mount DigitalMedia Transmitter (Knuckle Lounge 024 and Corridor 026):
1. General: Allows HDMI/DisplayPort/DVI-D and VGA signals to be transmitted using Digital/Media transport.
2. Features:
a. Transmits uncompressed digital video and audio over UTP/STP data cabling.
b. Supports video resolutions up to WUXGA 1920x1200 and HD 1080p60 Deep Color.
c. Supports 100' cable runs at 1080p 60Hz Deep Color using Crestron DigitalMedia cable.
d. Includes USB HID keyboard/mouse support.
e. HDCP support and CEC device control.
3. Acceptable Products:
a. Crestron DM-TX-200-C-2G-WALL.
b. Crestron CNPWS0-75 (1 required for Corr 026 system).

D. 6-Input DigitalMedia Switcher (Conference/Seminar Rooms):
1. General: Allows analog and digital media signals to be transmitted using DigitalMedia transport. Provides three DigitalMedia inputs.
2. Features:
a. Transmits uncompressed digital video and audio over UTP/STP data cabling.
b. Video Inputs: DVI-D, HDMI (DisplayPort Multimode compatible), DVI-I, and composite video/S-Video/component video.
c. Audio Inputs: Analog stereo (1 bal, 1 unbal), S/PDIF, HDMI embedded.
d. Supports video resolutions up to WUXGA 1920x1200 and HD 1080p60 Deep Color.
e. Supports 100' cable runs at 1080p 60Hz Deep Color using Crestron DigitalMedia cable.
f. Includes USB HID keyboard/mouse support.
g. HDCP support and CEC device control.
3. Acceptable Products:
a. Crestron DM-MD-6X1.

E. DigitalMedia Receiver:
1. General: Digital receiver supporting a single display device with video and control.
2. Features:
a. Compatible with Crestron DigitalMedia system using UTP and STP data cabling.

b. Supports 100’ cable runs at 1080p 60Hz Deep Color using Crestron DigitalMedia cable.
c. Outputs: HDMI with up to 7.1 channel audio, RS-232, 2 IR control ports, 2 relays..
d. Includes USB HID keyboard/mouse port.
e. HDCP support and CEC device control.
f. Control over LAN or DM NET.

3. Minimum Performance Requirements:
a. Video Formats: HDMI v.1.3a with Deep Color, DVI v.1.0, HDCP v.1.3 content protection support.
b. Audio Formats: Dolby® TrueHD 7.1, Dolby Digital Plus 7.1, Dolby Digital AC3 5.1, Dolby Digital EX 5.1, DTS-HD Master Audio™ 7.1, DTS-HD High Res 7.1, DTS 5.1, DTS-ES Matrix 5.1, DTS-ES Discrete 6.1, DTS 96/24 5.1, up to 8ch PCM.

4. Acceptable Products:
a. Crestron DM-RMC-100 (for DM CAT):
b. Crestron DM-RMC-100-S (for DM 8G+).
c. Crestron DM-RMC-SCALER-C (for Corr 026 system).

2.6 VIDEO SOURCE EQUIPMENT

A. Blu-ray DVD Player:
1. General:
a. High-definition DVD player compatible with Blu-ray, standard DVD, and CD discs.

2. Features:
a. Maximum output resolution: 1080p.
b. Component video output capable of 1080i resolution.
c. HDMI, component, S-Video, and composite video outputs.
d. Optical and coaxial digital audio outputs; 2-channel and 5.1-channel analog audio outputs. Dolby TrueHD, dts-HDDTS-HD Master Audio support.
e. HDMI v1.3a compatible.
f. RS-232C control.
g. Hand-held wireless remote control.

3. Acceptable Products:
a. Denon DVD-2010CI with Middle Atlantic RSH rack mount.
b. Yamaha BD-S2900 with Middle Atlantic RSH rack mount.
c. Pioneer Elite BDP-09FD with Middle Atlantic RSH rack mount.
d. Approved equal.

B. Document Camera:
1. Unit with integral progressive-scan video camera and lighting for the display of documents, illustrations, and three-dimensional objects on the projection screen or for including still images in video productions.
2. VGA-type computer video and USB. RS-232 remote control. Powered zoom.
3. Minimum Performance Requirements:
a. Resolution: 1024x768 pixels (XGA output), 1280x768 (WXGA output), 720p, 1366x768 (WXGA), 640 lines horizontal resolution (video output).
b. Frame Rate: 30 frames/second.
c. Iris/Focus: Automatic or manual.

4. Acceptable Product:
a. WolfVision VZ-8light^2.

2.7 VIDEO DISPLAY EQUIPMENT

A. 40" LCD Display:
1. General:
a. Flat panel display with minimum 40” diagonal viewing area at 16:9 aspect ratio.

2. Features:
   a. 178x178 degree viewing angle.
   b. HDMI, VGA, DVI-D, and DisplayPort inputs.
   c. Thickness with wall mount 1.75” max.
3. Minimum performance requirements:
   a. Resolution: 1920x1080.
   b. Brightness: 600 nit (cd/m2).
   c. Contrast Ratio: 5000:1.
   d. Response Time: 10 ms.
4. Acceptable Products:
   a. Samsung DE40A with Premier PTFM3765 ultra-thin mount.
   b. Approved equal.

B. 60" LCD Display:
1. General:
   a. Flat panel display with minimum 57-60” diagonal viewing area at 16:9 aspect ratio.
2. Features:
   a. 176x176 degree viewing angle.
   b. 3X HDMI, VGA, 2X Component Video, and S-Video inputs.
   c. Provide with optional AN-65AG1 wall bracket.
3. Minimum performance requirements:
   a. Resolution: 1920x1080.
   b. Brightness: 450 nit (cd/m2).
   c. Contrast Ratio: 2000:1.
   d. Response Time: 4ms.
4. Acceptable Products:
   a. Sharp LC-70LE733U with locking support bracket.
   b. Samsung 700DXn with locking support bracket.
   c. Approved equal.

C. 70" LCD Display:
1. General:
   a. Flat panel display with minimum 70” diagonal viewing area at 16:9 aspect ratio.
2. Features:
   a. 176x176 degree viewing angle.
   b. 3X HDMI, VGA, 2X Component Video, and S-Video inputs.
   c. Provide with optional AN-65AG1 wall bracket.
3. Minimum performance requirements:
   a. Resolution: 1920x1080.
   b. Brightness: 450 nit (cd/m2).
   c. Contrast Ratio: 2000:1.
   d. Response Time: 4ms.
   e. 176x176 degree viewing angle.
   f. Tuning system: ATSC/QAM/NTSC.
4. Acceptable Products:
   a. Sharp LC-70LE733U with locking support bracket.
   b. Samsung 700DXn with locking support bracket.
   c. Approved equal.

D. 80" LCD Display:
1. General:
   a. Flat panel display with minimum 80” diagonal viewing area at 16:9 aspect ratio.
2. Features:
   a. 176x176 degree viewing angle.
   b. 3X HDMI, VGA, 2X Component Video, and S-Video inputs.
   c. Provide with optional AN-65AG1 wall bracket.

3. Minimum performance requirements:
   a. Resolution: 1920x1080.
   b. Brightness: 450 nit (cd/m2).
   c. Contrast Ratio: 2000:1.
   d. Response Time: 4ms.
   e. 176x176 degree viewing angle.
   f. Tuning system: ATSC/QAM/NTSC.
4. Acceptable Products:
   a. Sharp LC-80LE632U with locking support bracket.
   b. Approved equal.

E. Video Projector (Typical Classroom):
1. Color video projector using one DMD panel.
2. Features:
   a. Composite, S Video, component, DVI, and RGB inputs Optional DVI, SD SDI, and HD SDI input modules.
   b. Digital keystone correction, Auto Pixel Alignment.
   c. Resolution: 1920x1200 pixels.
3. Minimum Performance Requirements:
   a. 4000 ANSI lumens, 270W NSH lamp.
   b. Compatibility with HDTV sources includes 1080p,1080I, 720p.
4. Acceptable Products:
   a. Panasonic PT-DZ570 with mounting bracket and spare lamp set.

F. Video Projector (Knuckle Lounge, Typical Teaching and Computer Labs):
1. Short-throw color video projector using three LCD panels.
2. Features:
   a. Composite, S Video, component, HDMI/DVI, and RGB inputs .
   b. Resolution: 1280x800 pixels (WXGA).
3. Minimum Performance Requirements:
   a. 3000 ANSI lumens.
   b. Compatibility with HDTV sources includes 1080p,1080I, 720p.
4. Acceptable Products:
   a. Sony VPL-SW535 with spare lamp (less wall mount).
   b. Epson PowerLite 485W with spare lamp.
   c. NEC U310W with spare lamp.

G. Video Projector Wall Mount (Knuckle Lounge, Typical Teaching and Computer Labs):
1. Wall mount for short-throw video projectors, provided with accessory loudspeakers.
2. Internal storage space for third-party devices.
3. Acceptable Products:
   a. Premier Mounts UNI-UFTP with UN-EMPB equipment mounting plate and UNI-SPKR accessory loudspeakers.
   b. Approved equal.

2.8 RACKS AND MISCELLANEOUS EQUIPMENT

A. Equipment Racks:
1. General:
   a. Equipment rack for standard 19" wide panels. Minimum 16 gauge cold rolled steel construction with louvered sides. Mounting rails with tapped 10-32 threaded holes on EIA spacings. Welded construction.
   b. Each rack furnished with permanently-mounted AC power 3 conductor grounded stripline rated for 15 amperes, with outlets on 6" centers, extending full height of rack, and with incandescent illumination attached for ease in servicing.
   c. Power for all rack equipment controlled by single master switch.
   d. Finish as approved by architect.

2. Free-Standing Deep Racks:
   a. Welded floor rack assembly, removable side panels.
   b. Sides of adjacent racks bolted together and not provided with side panels.
   c. Overall depth 25-1/2" min., height as indicated.
   d. Acceptable Products:
      1) Stantron FR Series with SS Series side panels.
      2) Soundolier 502 Series with 542 series side panels.
      3) GKM Mfg. Corp FR Series with PM panel mounting angles and 1/2 doors.
      4) Elkay Industries Series 225 with side panels.
      5) Middle Atlantic Products WRK Series with side panels and rear doors.
      6) Approved equal.
3. Racks in Millwork:
   a. Bolt-together rack frame with 10 or 15 rack units of space (11 or 16 RU by removing one cross brace). Can be modified for shorter heights.
   b. Overall depth 18" min.
   c. Acceptable Products:
      1) Soundolier 900 Series.
      2) Approved equal.
4. Compact Equipment Rack.
   a. Welded 16-ga steel wall-mount enclosure. Equipped with locking door and side vents. 14-3/4” deep (less door), 22-5/16” wide, 10 RU high.
   b. Acceptable Products:
      1) Atlas Sound 600-12-962
5. Wall-Mount Equipment Wall Rack and accessories:
   a. Equipment rack.
      1) Welded 16-ga steel sectional enclosure with corner braces for wall mounting. Equipped with adjustable, 10-32 threaded rack mounting rails, lockable center and rear sections, hinged for left or right opening, front and side vents. 22” deep, 35RU high.
      2) Acceptable Products:
         a) Middle Atlantic DWR-12-22.
   b. 12-unit plexiglass surface door:
      1) Acceptable Products:
         a) Middle Atlantic PFD-12.
6. Exposed Rack Hardware:
   a. All exposed rack hardware on the front face of the rack, including rack screw trim strips, ventilation panels and blank panels, provided with brushed and black anodized finishes.
   b. All rack equipment installed with shims as may be required so that the faces of all equipment, vent and blank panels are flush.
   c. Acceptable Products:
      1) Middle Atlantic Products TSA rack screw trim strips, VTP-2 vent panels, BL blank panels, and ST-series shim tabs.
      2) Approved equal.
7. Rack-Mount Drawer:
   a. Rack-mount storage drawer with latch or hold-in detents.
   b. Acceptable Products:
      1) Middle Atlantic Products TD Series.
      2) Approved equal.

B. Credenza Rack:
   1. Credenza with rack-mount rails and fan ventilation.
   2. Two rack bays.
   3. Finiish and style as approved by Architect.
   4. Acceptable Products:

a. Middle Atlantic Products C5F2-CSD-xx.
b. Approved equal.

C. Equipment Rackmount:
1. Custom fabricated rackmount system for use with equipment, such as consumer VCRs, that are not provided with integrated rackmount ears. Increases the height of the device to the next larger rack unit size, eliminating unsightly gaps and providing complete trim. Includes custom faceplate with ears, and rackshelf with ventilated bottom.
2. Black brushed and anodized faceplate finish.
3. Acceptable Products:
a. Middle Atlantic Products RSH-4A with faceplate and shelf size as required.
b. Approved equal.

D. Security Covers:
1. Perforated cover panels to prevent unauthorized tampering with equipment controls. Panels to provide 22% open area to allow viewing of LED indicators and controls. Opposing corner notches to allow equipment to stay racked when cover is removed.
2. Acceptable Products:
a. Middle Atlantic SF series.
b. Approved equal.

E. Blank Panels:
1. 16-gauge flanged solid steel with black smooth or textured enamel finish.
2. Acceptable Products:
a. Middle Atlantic SB series
b. Atlas/Soundolier S19 series
c. Approved equal.

F. Vented Panels:
1. 16-gauge flanged perforated steel with black smooth or textured enamel finish.
2. Acceptable Products:
a. Middle Atlantic VTF series
b. Atlas/Soundolier SVP19 series
c. Approved equal.

G. Connectors:
1. Microphone and Line Connectors (Panel Mount):
a. Unbalanced Cable-End: Two-conductor RCA plug or jack connector with steel shell and internal cable clamp. Provide with minimum 2" of rubberized shrink-wrap strain relief at each connector.
1) Acceptable Products:
a) Switchcraft 3502 or 3503 as required.
b) Canare RCAP Series.
b. Balanced Input Receptacles: female gender "XLR"-type receptacles.
1) Acceptable Products:
a) Switchcraft C3F or D3F.
b) Neutrik NC3FP-1 or NC3FDL-1.
c. Balanced Output Receptacles: Male gender "XLR"-type receptacles.
1) Acceptable Products:
a) Switchcraft C3M or D3M.
b) Neutrik NC3MP or NC3MDL-1.

2. Microphone and Line Connectors (Cable Mount):
   a. Balanced Input Connectors: female gender “XLR”-type connectors.
      1) Acceptable Products:
         a) Switchcraft A3F.
         b) Neutrik NC3FX.
   b. Balanced Output Connectors: male gender “XLR” type connectors.
      1) Acceptable Products:
         a) Switchcraft A3M.
         b) Neutrik NC3MX.
3. Multipin Receptacles and Connectors:
   a. Number of contacts as required to provide indicated functions.
   b. Mating cable connectors.
   c. Acceptable Products:
      1) AMP CPC (Circular Plastic Connectors) with Type II contacts, housings, etc., as required.
      2) Approved equal.
4. Video Receptacles:
   a. Insulated, feed-through BNC panel jack with beryllium copper outer conductor spring for use with RG-59/U-type cables.
   b. Cable termination: BNC.
   c. Acceptable Products:
      1) Trompeter UBJ28.
      2) KingsKC-99-54.
      3) ITT Pomona3846.
      4) Canare BCJ-JR with IU-7/16 panel isolation bushing.
5. Video Cable Connectors:
   a. BNC type for terminating video cable in conduit or video extension cables. Crimp connector with beryllium copper outer conductor spring and captive center pin, exceeding MIL-C-390l2,A.
   b. For Belden 8281 or 8281B type cable.
      1) Acceptable Products:
         a) Kings 2025-58-9.
6. RCA type connector for RG-59/U Type Video Cables:
   a. 75 Ohm true impedance matched RCA type connector.
   b. Crimps to any RG-59 type cable.
   c. VSWR 1.1 or less to 200 MHz.
   d. Fully captive gold plated center pin.
   e. Nickel plated brass body with Beryllium copper outer contacts.
   f. Acceptable Products:
      1) Canare RP-C4 series with TC-1 Crimp tool and TCD-series crimp die.
      2) Approved equal.
7. Heavy-Duty RJ-45 Connectors:
   a. Standard CAT 5e RJ-45 connectors housed in XLR-type connector shell for physical protection.
   b. Acceptable Products:
      1) Neutrik NE8FAV-Y110 panel connector, NE8MC cable connector, and BSE and ACRF color-coded accessories.

H. Cable Markers:
   1. High-grade PVC clip-on or permanent-type cable markers with permanent markings, or printed vinyl tape protected by clear shrink tubing or adhesive wrap.

2. Acceptable Products:
   a. Electrovert Type C or Z.
   b. Brady B-702 with Alpha FIT-221 series clear tubing.
   c. Thomas & Betts EZCODER.

I. Wire and Cable:
1. Cable for Installation in Conduit or Wireways or Within Racks:
   a. Microphone, PC, and Line Level Lines:
      1) Twisted pairs of color-coded stranded conductors with overall foil shield, stranded tinned copper drain wire, and jacket. AWG #22, maximum diameter .175 inches.
      2) Acceptable Products:
         a) Belden 8761.
         b) West Penn 291.
         c) Alpha 2401.
         d) Liberty 22-2C-SH-GRY.
   b. Loudspeaker Lines: (#16):
      1) Twisted color-coded stranded and paired conductors with overall jacket. Gauge as shown on drawings. AWG #16, nominal diameter .256 inches.
      2) Acceptable Products:
         a) Belden 8471.
         b) West Penn 225.
         c) Alpha 5600/1601.
         d) Liberty 16-2C-GRY.
         e) Extron SPK 16.
   c. Category Six Data Cable:
      1) Four-pair unshielded twisted pair cable, AWG#24, nominal diameter 0.240”. Meets requirements for Category Six applications.
      2) Minimum Performance Requirements:
         a) Nominal Capacitance: 1.1 pF/ft at 1 KHz.
         b) Impedance: 100 ohms ±12%, 0-350 MHz.
         c) Attenuation: 32.8 dB/100m at 250 MHz.
      3) Acceptable Products:
         a) Belden DataTwist 7881A.
         b) Liberty 24-4P-L6.
         c) Approved equal.
   d. Remote Control Lines (RC):
      1) Color-coded stranded copper conductors with overall jacket.
      2) AWG #18, with number of conductors as required.
      3) Acceptable Products:
         a) Alpha 5062 to 5070, as required.
         b) Approved equal.
   e. Video Lines (RG59):
      1) Low-noise coaxial cable with polyethylene dielectric, double copper braid shield, and overall PVC or polyethylene jacket.
      2) Nominal Attenuation: 0.78 dB/100 ft. at 10 MHz.
      3) Nominal Impedance: 75 ohms.
      4) AWG #20 solid bare copper center conductor, nominal cable O.D. .198 inches.
      5) Acceptable Products:
         a) Belden 8281B.
         b) West Penn P806.
         c) Approved equal.

f. RGBHV Video Lines (RG59):
   1) Bundle of five low-noise coaxial cables with polyethylene dielectric, double copper braid shield, and overall PVC or polyethylene jacket, in overall jacket.
   2) Nominal Attenuation: 3.8 dB/100 ft. at 270 MHz.
   3) Nominal Impedance: 75 ohms.
   4) AWG #20 solid bare copper center conductor, nominal cable O.D. .792 inches.
   5) Acceptable Products:
      a) Liberty RGB5C-20-CMR.
      b) Extron RGB/SHR-5.
      c) Approved equal.
g. Miniature RGBHV Video Lines (RG59):
   1) For runs of less than 50 feet only.
   2) Bundle of five low-noise coaxial cables with polyethylene dielectric, double copper braid shield, and overall PVC or polyethylene jacket, in overall jacket.
   3) Nominal Attenuation: 9.1 dB/100 ft. at 270 MHz.
   4) Nominal Impedance: 75 ohms.
   5) AWG #25/6 solid bare copper center conductor, nominal cable O.D. .478 inches.
   6) Acceptable Products:
      a) Liberty RGB5C-SOL-MINI.
      b) Extron BNC-5 Mini HR.
      c) Approved equal.
h. RS-232 Data Cable for Runs Over 50 Feet:
   1) Number of stranded conductors as required, with overall shield, AWG#24, nominal diameter .225 inches.
   2) Capacitance: 12 pF/ft ±2 pF/ft for data transmission up to 500'.
   3) Acceptable Products:
      a) Belden 9925 Series.
      b) Black Box Extended Distance Data Cable.
      c) Approved equal.
i. Control System Network Cable:
   1) Two twisted pairs with overall jacket.
   2) AWG #18/22 stranded.
   3) Acceptable Products:
      a) Liberty Cresnet or AXLINK.
      b) Approved equal.
j. DigitalMedia Cable:
   1) Three twisted pair cables with overall jacket compatible with Crestron DigitalMedia transmission, one cable CAT5e UTP type, one cable CAT6 STP type, and one cable two pair for DM Net.
   2) Acceptable Products:
      a) Crestron DM-CBL-NP.
      b) Approved equal.

2. Cable for Installation in Air Return Plenums:
   a. Microphone and Line Level Lines:
      1) Twisted pairs of color-coded stranded conductors with overall foil shield, stranded tinned copper drain wire, and jacket. AWG #22, maximum diameter .175 inches.
      2) Acceptable Products:
         a) Belden 88761, 87761, or 83761.
         b) West Penn 25291.
         c) Liberty 22-2C-PSH-WHT.

d) Extron STP 22 Plenum.
e) Equivalent.Loudspeaker Lines (#16):
1) Twisted color-coded stranded and paired conductors with overall jacket.
2) AWG #16, nominal diameter .162 inches.
3) Acceptable Products:
a) West Penn 25225.
b) Liberty 16-2C-P-WHT.
c) Extron SPK 16 Plenum.
d) Equivalent.

c. Category Six Data Cable:
1) Four-pair unshielded twisted pair cable, AWG#24, nominal diameter 0.240". Meets requirements for Category Six applications.
2) Minimum Performance Requirements:
a) NEC CMP rating.
b) Nominal Capacitance: 1.1 pF/ft at 1 KHz.
c) Impedance: 100 ohms ±12%, 0-350 MHz.
d) Attenuation: 32.8 dB/100m at 250 MHz.
3) Acceptable Products:
a) Belden DataTwist 7882A.
b) Liberty 24-4P-P-L6.
c) Approved equal.

d. Control System Network Cable:
1) Two twisted pairs with overall jacket.
2) AWG #18/22 stranded.
3) NEC CMP rating.
4) Acceptable Products:
a) Liberty Cresnet-P.
b) Approved equal.

e. Video Lines (RG59):
1) Low-noise coaxial cable with polyethylene dielectric, double copper braid shield, and overall PVC or polyethylene jacket.
2) NEC CMP rating.
3) Nominal Attenuation: 0.78 dB/100 ft. at 10 MHz.
4) Nominal Impedance: 75 ohms.
5) AWG #20 solid bare copper center conductor, nominal cable O.D. .185 inches.
6) Acceptable Products:
a) Belden 88281.
b) Approved equal.

f. RGBHV Video Lines (RG59):
1) Bundle of five low-noise coaxial cables with polyethylene dielectric, double copper braid shield, and overall PVC or polyethylene jacket, in overall jacket.
2) NEC CMP rating.
3) Nominal Attenuation: 3.8 dB/100 ft. at 270 MHz.
4) Nominal Impedance: 75 ohms.
5) AWG #20 solid bare copper center conductor, nominal cable O.D. .792 inches.
6) Acceptable Products:
a) Liberty RGB5C-20-CMR.
b) Extron RGB/SHR-5.
c) Approved equal.

g. Miniature RGBHV Video Lines (RG59):
   1) For runs of less than 50 feet only.
   2) Bundle of five low-noise coaxial cables with polyethylene dielectric, double copper braid shield, and overall PVC or polyethylene jacket, in overall jacket.
   3) NEC CMP rating.
   4) Nominal Attenuation: 8.8 dB/100 ft. at 270 MHz.
   5) Nominal Impedance: 75 ohms.
   6) AWG #26 solid bare copper center conductor, nominal cable O.D. .536 inches.
   7) Acceptable Products:
      a) Liberty RGB5C-PLN-1.
      b) Extron BNC-5 Mini HRP.
      c) Approved equal.

h. DigitalMedia Cable:
   1) Three twisted pair cables with overall plenum-rated jacket compatible with Crestron DigitalMedia transmission, one cable CAT5e UTP type, one cable CAT6 STP type, and one cable two pair for DM Net.
   2) Acceptable Products:
      a) Crestron DM-CBL-P.
      b) Approved equal.

J. Digital Video Adapters:
   1. DisplayPort to HDMI Video Adapter:
      a. Video adapter to allow a computer with a DisplayPort video output connector to be connected to an HDMI input.
      b. Maximum Resolution: 1920x1200.
      c. Acceptable Products:
         1) StarTech.com DP2HDMI.
         2) Dell A2125395.
         3) CablesToGo 54130.
   2. DVI to HDMI Video Adapter:
      a. Video adapter to allow a computer with a DVI video output connector to be connected to an HDMI input.
      b. Male DVI-D to female HDMI.
      c. Maximum Resolution: 1920x1200.
      d. Acceptable Products:
         1) Extron HDMIF-DVIDM.
         2) MonoPrice.com 2029.
         3) Gefen ADA-DVIM-2-HDMIF.

K. Table Box:
   1. Table top box with flush lid containing AV power outlet and provisions for retaining audio and video cables, permitting cables to be pulled from box for attachment to portable equipment. Cable storage below box in interior of furniture. Provided with spaces for three connector adapter plates.
   2. Finish as approved by Architect.
   3. Acceptable Products:
      a. Extron Cable Cubby 300S with 3 AAPs, as required.
      b. Approved equal.

L. Projector Ceiling Box:
   1. 1’x2’ ceiling box with 1-1/2” NPT female fitting to accept projector pole mount and mounting brackets to support electronic devices.
   2. Features:
      a. Replaces 1x2 ceiling tile.

b. Contains five AC power outlets.
c. Provided with fan for positive cooling.

3. Acceptable Products:
a. FSR Inc. CB-12P with CB-12FAN fan kit.
b. Approved equal.

M. Projector Ceiling Mount:
1. UL approved, steel ceiling mount provided with adjustable tubular steel column suspended from above. Projector mount plate with roll, pitch and yaw adjustments; supports and mounting kit custom designed for designated projector. Keyed security lock; all mounts keyed alike.
2. Acceptable Products:
a. Chief RPM Series with CMA ceiling mount accessories as required and at least two keys for entire project.
b. Approved equal.

N. Flat Panel Display Wall Mounts:
1. UL approved, steel wall mount provided with mounting bracket to mate with standard VESA bolt pattern on display.
2. Types: Flat (parallel to wall, no tilt), tilting (adjustable down angle), and swing-arm (adjustable tilt and side angle).
3. Acceptable Products:
a. Fixed: Chief LSTU.
b. Tilt: Chief LTTU.
c. Swing-Arm: Chief MPW.
d. Approved equal.

O. Flat Panel Display Ceiling Mounts:
1. UL approved, steel ceiling mount provided with mounting bracket to mate with standard VESA bolt pattern on display.
2. Acceptable Products:
a. Chief JHS.
b. Approved equal.

P. Receptacle Backbox Covers:
1. General: Appearance and finish as approved by Architect. Provided with engraved legends as specified and shown on drawings.
2. Standard NEMA Gang-Size Covers: Single or multi-gang steel covers, punched as required to receive receptacles.
3. Custom Covers for Large Backboxes: Min. 1/8" thick aluminum or steel covers, punched as required to receive receptacles.

PART 3 - EXECUTION

3.1 GENERAL

A. All types of equipment installed by competent workers at locations shown on the drawings in strict accordance with approved shop drawings and manufacturer's instructions.

B. All equipment except portable equipment firmly held in place. This shall include loudspeakers, enclosures, amplifiers, cables, etc. Fastenings and supports adequate to support their loads with a safety factor of at least three unless otherwise stated.

C. Take such precautions as necessary to prevent and guard against electro-magnetic and electro-static hum and to install the equipment so as to provide safety for the operator.

D. Protect all equipment, including patch panels, connectors, receptacles, racks, consoles, and video projectors, from construction dust and debris until final acceptance of the system.

3.2 LABELS

A. Except where otherwise specified, label as shown on drawings and as specified each item of rack-mounted equipment, all switches, controls, and receptacles.
   1. Switch and Control Panels: Constructed of engraved and filled anodized aluminum plates. Minimum 1/8" plate thickness. Dry transfer or other types of adhesive labels not acceptable.
   2. Rack-Mounted Equipment: Labels constructed of engraved and filled plastic laminate engraving stock. Designate function and input and output line(s) or loudspeaker(s) served by labeled equipment. Key all designations to system functional and patch panel diagrams. Where possible, mount labels on blank panel directly above corresponding component. For modular equipment, provide label on inside of mainframe door identifying type of module for each slot (unless there is only one type) and gain setting as established at final checkout.
   3. Identification Panel: Install panel with 1/8"-high engraved characters on the front of the bank of equipment racks serving each space. Clearly identify the Project, System Installation Contractor, Architect, and System Designer in the following format:

PROJECT:	Owner’s Name Address Room or spaces served Owner’s Technical Support Telephone
SYSTEM DESIGNER:	Acentech Incorporated 33 Moulton Street Cambridge, MA 02138 (617) 499-8000
INSTALLATION CONTRACTOR:	Company Name Address Telephone
PROJECT ARCHITECT:	Company Name Address Telephone

   4. Receptacles: Engrave and fill receptacle label directly on mounting plate as follows:
      a. Microphone Receptacles: Engraved "MIC", with circuit number corresponding to drawings.
      b. Line-Level Receptacles: Engraved "LINE", with circuit number corresponding to drawings.
      c. Video Receptacles: Engraved "VIDEO" with circuit designation corresponding to drawings.
      d. Remote Control Receptacles: Engraved "Remote Control" with designation of item to be controlled.
      e. Or as indicated on drawings.

B. Identify all wires and cables at every termination and connection point with the specified cable markers. The contractor is strongly encouraged to use a numbering scheme that identifies all cables terminating at patch panel jacks with the patch bay row and jack designation; use A, B, and C suffixes to distinguish multiple cables terminating at the same jack.

C. Identify switches, relays, terminal blocks, etc., with reference numbers keyed to the as-built wiring diagrams.

D. Room numbers appear on the contract documents for reference only. All labels shall reflect the Owner's final room designations.

E. All labels and legends shall be as approved on shop drawings.

3.3 MICROPHONE EQUIPMENT

A. General:
1. Excluding wireless microphones, each portable microphone provided with case, stand adapter, and min. 15 ft. cable with attached XLR-type connector.

B. FM Wireless Microphone System:
1. Obtain suggested operating frequencies and Licensing Form 400 from regional FCC offices.
2. Verify that selected operating frequencies are free of interference from external sources.
3. File license application in owner's name.
4. Orient antennas as recommended by manufacturer. Locate in positions shown on drawings.
5. Terminate all unused RF inputs and outputs.
6. Antenna Cables: Use specified low-loss 6/U (75 ohm) or 8/U (50 ohm) cable, impedance as required.
7. Except for transmitter equipment, all equipment including preamps and active combiners requiring DC power provided with power supplies or powered by receivers (battery operation is not acceptable).
8. Do not mount antennas or attached preamplifiers directly to any metal structure. Mount at least 3 ft. from any large metal object.

3.4 CONTROL EQUIPMENT

A. Audiovisual Control System:
1. Carefully coordinate with manufacturer and with Architect the dimensions and mounting conditions of all items.
2. Provide all required cable, relays, and miscellaneous hardware to interface the audiovisual control system with the preset lighting systems, front projection screens, and drape mechanisms.
3. Install all components so as to use the maximum amount of any tally signals provided by the controlled equipment, including lighting dimmer systems and video cassette decks.
4. Mount the IR emitter probes to the IR windows of the indicated equipment with one drop of clear hot glue in a manner that allows unimpeded IR communications and secure mounting. Secure probe cables to prevent probe from being accidentally pulled from equipment during normal system operation.
5. Set up control system hardware for rooms with identical systems identically, with control lines connected to the same terminals of the same card type with the same ID numbers, in order to facilitate initial programming and future service.
6. Request from the Owner all IP addresses required for systems and standalone devices.

B. Audiovisual Control System Programming:
1. Use Crestron SystemBuilder software to program control systems in order to provide user-friendly means of updating drivers for particular equipment items (in particular, the driver for the video projector in the Studio Theater).
2. Program system or instruct AV Control System Manufacturer to program system as instructed by the AV Consultant and the Owner, and as indicated on the drawings so that all devices are controlled in a logical manner, and to take full benefit of the capabilities of the Control System.
3. Refine and adjust, as required, programming to operate in a logical and consistent fashion. Make revisions to program as directed by the AV Consultant at checkout to correct operational inconsistencies or to properly control devices.
4. Ascertain that the system is optimally programmed for smooth transitions between media uses and for minimal wear-and-tear on equipment and audiovisual media including tapes and discs.

5. Verify that tape or disc transports, etc., are stopped when another input source is selected.
6. Wherever possible utilize status feedback of source equipment, dimming systems, etc., to indicate to the control system and user the actual operating mode of the equipment. When feedback is not available (e.g. consumer VCR's) program control system to issue commands as required to minimize status reporting errors.
7. Program control system to avoid frequent powering down of video projectors by employing the standby mode to simulate turn-off with actual turn-off occurring only after a programmable delay of several hours.
8. Program systems in all rooms with identical systems identically so that one version of software exists for each set of identical rooms. For rooms with system that are identical in part (e.g. distance learning classrooms and standard case-study classrooms), use identical code for identical portions of system software.
9. Program control system front-panel buttons and LCD screen to allow control of presentation-related functions (projector power, input switching, router control, etc.) should system control panels be non-functional or missing.
10. Program control system to allow control of lighting control system presets and feedback of active preset over IP.
11. Information Commons: Program Digitorium control system to control volume of sound for steerable column loudspeaker system located in Information Commons.

C. Touch-Screen Control Panels:
1. Design panel graphics (including text, buttons, colors, images, backgrounds etc.), panel flips, sub-panels and overall screen logic flow to be similar to other campus systems (examples are to be furnished by Owner), except where differences in system architecture require different control structure. Notwithstanding the preceding, the programmer is encouraged to exploit the full capabilities of the control system, both functionally and graphically to provide the best possible control interface. The intent of this paragraph is not to restrict design creativity but to direct the design in a such way that the resulting systems will appear familiar to users of other systems on campus, thereby minimizing their learning curve.
2. Within 90 days of contract award, submit initial panel graphic layouts with description of button responses for review by the consultant and owner. Revise and resubmit as required to incorporate comments. Do not proceed with basic control system programming (except for modules not affected by the control panel design) before final approval of control panel designs.
3. Make any adjustments, revisions, modifications, etc. to the control system required for complete, error-free, operation.
4. General control panel programming guidelines:
   a. Graphical user interface is to be designed to follow the design principles of existing campus control systems, modified as required to provide control features not provided by existing systems. Notwithstanding the preceding, contractor is encouraged to exploit the full graphical capabilities of the control panel hardware and software to provide a "state-of-the-art" interface. Examples of existing GUI designs will be provided by University.
   b. Provide opening welcome screen for all systems containing school seal or other appropriate graphic with label to "Touch Screen to Activate System".
   c. Use of icons and graphic symbols is encouraged; however, except for certain universally-recognized icons, symbols should be supplemented with text labels to clarify meaning.
   d. Use of subpages is encouraged to reduce unnecessary page flips. Buttons with major consequences, such as system power buttons, should not immediately initiate the corresponding action but rather call a subpage containing a message "Are you sure you want to . . ." and appropriate response buttons as a protection against accidental activation of the system function.

e. All tape and disc transport controls shall behave similarly, whatever the behavior of the transport's front-panel controls (e.g. PAUSE will only have effect when transport is in PLAY; pressing PAUSE again or the PLAY button will resume play and unhighlight PAUSE).
f. Provide stand-alone application to duplicate all control panel functionality for each room using IP protocols over ethernet.
g. Program control systems to provide email notification to persons designated by the Owner when projector lamps fail or reach 90% of their rated life.
h. Program control systems to turn off video projectors after defined period of time of control system inactivity. Length of time period to be set on a "technician" control page. At 1-2 minutes for projector turn-off, change projector input; if touch-screen is "woken up" before end of time period, cancel projector turn-off sequence and restore previous projector input.
i. Program system to query status of video projector or in some other way elicit a communication response from projector at time intervals not to exceed 15 seconds. If projector fails to respond (i.e. the projector has been disconnected) control system shall send email notification to persons designated by the Owner.
j. When the AV system is turned off, the projection screen(s) will be raised, all controlled equipment with the exception of the video projector will be turned off, and countdown timer for video projector shutdown started. Timer will operate similarly to paragraph g above but will have its own separate time setting.
k. All control systems are to be linked to the existing campus Crestron Fusion RV control software and utilize the reporting and supervision capabilities of the software to the extent possible. Provide Xpanel versions of the control software for each room.
l. Provide buttons to allow selection of Native or Fill display of sources and report on touchpanels the frequency and resolution information of the selected source.

3.5 VIDEO EQUIPMENT

A. Video Projectors:
1. Verifications:
a. Verify lens selection, locations, and elevations shown on drawings using manufacturer's throw distance and elevation formulas for specified projector model.
2. Submittals:
a. Provide plan and section drawings verifying image width, lens-to-screen distances and mounting methods.
b. Provide detailed drawings of custom-fabricated or stock mounts and hardware.
c. Provide detailed drawings of millwork or finish items required for specified screen dimensions.
d. Where mirrors are required, provide detailed drawings of mounting angles, reflection rays, support structures and hardware.
e. Where projector mounts or motorized lifts are installed by others, all drawings must indicate installation positions allowing optimal projector performance.
3. Mounting:
a. Install projector mount and suspend projector at location and elevation indicated on approved shop drawings.
b. Projector mounts and motorized lifts must meet all applicable safety and code requirements for ceiling mounted equipment.
c. Fixed projector mounts must be rigid and completely free of sway or rotation deviation.
d. Projector support pipes shall be only fixed-length pipes as required—do not use adjustable-length pipes.
e. For ceiling mounted installations where screen surfaces are vertical, level projector at 0° front-to-back and side-to-side.

f. Position projector centered on screen centerline in plan unless projector is provided with horizontal lens shift capability. Do not employ vertical or horizontal electronic keystone correction unless specifically authorized to do so.
g. Wherever possible, minimize hardware and cables visible from audience seating and presenter area view points.
h. Paint exposed mounting hardware to match room interior or as instructed by Architect.
i. Where structural mounts or millwork openings are provided by others, verify correct positioning and dimensions before mounting projector. Provide written notification to the Owner or Architect of any discrepancies in mount positioning or stability deficiencies before projector installation.
j. Where rear projection screen millwork is provided by others, provide written notification to the Owner or Architect of any discrepancies opening dimensions before screen or projector installation.
k. Provide all necessary projector brackets, fittings, pipes, miscellaneous hardware and wireways.
l. Run cabling from video projector box to projector within projector support pipe.
m. Provide approved security cable for video projectors to accept padlock provided by owner.

B. Flat Panel LCD Displays:
1. Submittals:
a. Provide elevation drawings showing location of LCD displays for approval. Where display is part of a larger graphic display, verify exact location of display with Architect.
2. Mounting:
a. Install display mount and display at location and elevation indicated on approved shop drawings.
b. For wall –mounted displays, provide mount to support display from blocking, if provided, or from wall studs. If a recessed box is provided behind display for power outlets and electronic accessories, provide mount that does not obstruct access to box.
c. Wherever possible, minimize hardware and cables visible from audience seating and presenter area view points.
d. Where display is mounted in an architectural recess, verify that sufficient clearance (2” minimum) is provided for ventilation airflow.
e. Provide display mounts with security provisions to accept owner-provided padlocks.

C. Pan/Tilt Video Cameras:
1. Submittals:
a. Provide elevation drawings showing location of cameras for approval. Where display is part of a larger graphic display, verify exact location of display with Architect.
2. Mounting:
a. Install cameraat location and elevation indicated on approved shop drawings using approved wall mount or ceiling mount bracket.
3. Control:
a. Program control system to provide presets for principal views for each camera and provide means for users to modify presets.
b. Executive Board Room N7303: Two cameras connected to dual-window processor are to provide a view of both sides of the table on one display using both camera images stacked one above the other.

3.6 LOUDSPEAKER EQUIPMENT

A. Playback Loudspeakers:

1. Support loudspeakers below ceiling using specified ceiling mount with loudspeakers aimed to provide optimum coverage of listening area.
2. Position loudspeaker to avoid interference with operation of projection screens and obstruction of loudspeaker sound distribution by the screens.
3. Program digital audio processor to use all four playback loudspeakers in the large-screen room mode, with the loudspeakers at the smaller screen covering the sloped seating area with a delay to time their sound arrival to be 5-20 msec. after the sound from the loudspeakers at the larger screen.

B. Ceiling Loudspeaker Enclosures and Grilles:
1. Loosely fill all enclosures with nominal 1-1/2 lb. per cu. ft. density fiberglass.
2. Ceiling Enclosures: Enclosures supported directly from ceiling structure in an approved manner. Support directly by acoustical ceiling tile is NOT ACCEPTABLE. Position loudspeakers above and within ½" of the perforated metal ceiling tiles, centered on the tiles, but not in contact with them.

3.7 RACKS, CABLES, CONNECTORS, AND MISCELLANEOUS EQUIPMENT

A. Wiring and Interconnections:
1. General:
a. Exercise care in wiring to avoid damage to cables and equipment.
b. Make all joints and connections with rosin-core solder or approved mechanical connectors, except mechanical connectors are NOT acceptable on microphone lines. Connections to transformer leads for distributed loudspeakers may be made using properly-sized wire nuts or nylon-insulated pigtail crimp connectors such as Waldom CE series. Wire nuts are not acceptable except at individual loudspeakers.
c. All connections to screw-type terminals shall be made using spade lugs. Bare or tinned wire is not acceptable.
d. All connections to lugless compression-type screw terminals shall be made using bare wire only. Do not tin wire.
e. All wiring executed in strict adherence to standard broadcast practices. This includes:
1) Dress cables in conveniently sized bundles, combed into parallel runs, either laced or banded with sufficient plastic ties.
2) For equipment mounted on glides, or otherwise requiring servicing from the front of the rack incorporate a cable "service loop" of sufficient length to permit the equipment to be pulled forward from the rack for servicing.
3) Support cables and bundles with sufficient plastic ties and support bars to ensure that no strain is placed on any connections or connectors.
4) Organize cables and cable bundles behind patch bays to permit easy access to the patch panels to add or remove cables.
5) Place cable markers 3"-5" back from video connectors to permit easy viewing. Do not bind markers into cable bundles.
f. All audio signal lines carried by twisted-pair cable and switched with two poles per line unless noted otherwise. Do not tie one side of audio line to other audio lines.
2. Grounding:
a. Ground equipment, racks, and audio line shields to independent audio system ground ONLY as shown on drawings. If not shown on drawings, ground case of power striplines in equipment racks to the racks and directly to isolated ground buss in the power panel or to power system ground at the building AC service entry only.
b. Ground all conduits ONLY to power system ground. Insulate all conduits and electrical boxes from sound system, including equipment racks and audio system ground.

c. Insulate all conductors in conduit, including shields, from the conduit, back boxes, and from each other for the entire conduit length.

3. Equipment Racks:
   a. Install equipment in racks to permit access to all equipment for service. Transformers, relays, terminal blocks, etc., mounted in rear of racks behind other equipment shall not prevent access to equipment connections or shall be mounted on hinged panels to permit access.
   b. Wire all racks completely in the shop. No internal rack wiring to be done on the job site.
   c. Install equipment in racks with ventilating panels as required to provide adequate ventilation and according to equipment manufacturer's recommendations.
   d. Connect all microphone, DC control, and line level cables to equipment racks via specified audio terminal blocks. External lines to patch bay terminated directly on patch bay terminal blocks.
   e. Connect loudspeaker lines with equipment racks via specified terminal blocks. Use spade lugs if barrier strips are used. Do not buss commons together. Do not ground.
   f. No signal or control lines shall leave a rack without connecting via terminal blocks.
   g. Provide unused panel space with blank or ventilating panels as shown on drawings.
   h. Provide security covers, knob covers, or shaft locks for any rack-mounted equipment with front panel controls that are not intended for adjustment by the operator or users and that do not have other means of control security. Examples of such equipment include equalizers and permanently-set mixers.
   i. Locate free-standing racks as indicated and to provide access to rear.
4. Conduit:
   a. Run all lines in metallic conduit or wireways unless otherwise indicated. Run microphone level, line level, loudspeaker level, and DC control wiring each in separate conduit.
   b. Do not locate AC power lines in conduit containing audio or video lines.
   c. Do not splice lines in conduit.
5. Receptacles:
   a. Provide finish sample for approval by Architect.
   b. Wall-mounted receptacles in metal boxes at building standard receptacle height unless otherwise indicated.
   c. Floor-mounted receptacles in flush floor boxes with flush lids.
6. Unbalanced Receptacles:
   a. Install 1/4" phone or RCA jacks to mounting plates with insulating washer and sleeve to electrically isolate the jack from the electrical box and conduit.
7. Video Receptacles:
   a. Install feed-through BNC receptacles to mounting plates with insulating washer and sleeve to electrically isolate the receptacle from the electrical box and conduit.
   b. Punch receptacles with "D" hole to prevent receptacle rotation within hole.

3.8 SYSTEM PERFORMANCE TESTS AND ADJUSTMENTS

A. Test all equipment to verify conformance with manufacturer's performance specifications and with this specification.

B. Audio Systems:
   1. Absolute Impedance:
      a. Set any loudspeaker level controls at zero attenuation. Measure absolute impedance value of each loudspeaker line at 250, l000, and 4000 Hz, without amplifier connected but with all loudspeakers connected. Impedance shall be at least 90% of rated load impedance of respective amplifier. Check resistance of

lines to all loudspeaker and microphone receptacles, with receptacles open and short circuited.

2. Hum and Noise Level:
   a. Adjust gain controls for optimum signal-to-noise ratio and full amplifier output with -55 dBm level at a microphone input and 0 dBm at line-level input.
   b. Without changing gain, terminate microphone and line-level inputs with shielded resistors of l50 and 600 ohms, respectively.
   c. Measure overall hum and noise level at each power amplifier output for each input channel. Level shall be at least 80 dB below rated power output of amplifier over a bandwidth of 20-20,000 Hz.
3. Electrical Distortion:
   a. Load power amplifiers with resistors matching nominal impedance of output terminals used in system in place of actual loudspeaker loads.
   b. Adjust gain controls as for hum and noise level tests.
   c. Apply 1000 Hz size-wave signal from an oscillator having less than 0.l% total harmonic distortion to each microphone and line-level input at level required to produce measured full amplifier output.
   d. Distortion shall measure less than 0.l%.
4. Parasitic Oscillation and RF Pickup:
   a. Set up system for each specified mode of operation.
   b. Use 50 - 100 MHz bandwidth oscilloscope and loudspeaker monitoring.
   c. Check to ensure that system is free of spurious oscillation and RF pickup in the absence of any input signal and also with system driven momentarily to full output at l60 Hz.
5. Buzzes, Rattles, Distortion:
   a. Apply high-quality music signal to the system. Adjust the system for frequent peaks at its specified maximum sound pressure level.
   b. Apply sine-wave sweep from 50-50,000 Hz at 6 dB below full amplifier power.
   c. In both cases, listen carefully for buzzes, rattles, and objectionable distortion.
   d. Correct all causes of such defects. If cause is outside the system, promptly notify the Owner or Owner's authorized representative and his Consultant, indicating cause and suggested corrective procedures.
6. Level Balance: Adjust level controls for all items of similar equipment for identical measured voltage gain.
7. Measure system acoustical performance using a sound level meter set for "slow" meter damping except as otherwise noted, and flat response with random incidence at a height of 4 to 5 feet. All interior finishes and furnishings shall be in place, and system gain shall be adjusted to provide levels of 70 to 80 dB and at least l0 dB above background noise at the measuring locations for these tests, except as otherwise noted. Include the following tests and adjustments:
   a. Frequency Response:
      1) Measure loudspeaker frequency response with all control equalization set for flat response, using l/3-octave bands of filtered pink noise centered on ANSI preferred frequencies, or broadband calibrated pink noise measured in l/3-octave bands using a calibrated real-time analyzer.
      2) Adjust equalization to provide average system response within ± 3 dB of a response (0 dB) which is flat from 63-2500 Hz and slopes uniformly from 0 dB at 2500 Hz to -5 dB at 10,000 Hz.

b. Uniformity of Coverage:
   1) Use 4000 Hz octave band of random noise as test signal output to loudspeakers.
   2) Lateral Uniformity: ± 2 dB at all positions equidistant from front of hall.
   3) Front-to-Back Uniformity: Decreasing linearly within ± 2 dB from 0 dB at front of hall to -6 dB at rear as measured on the hall center line.
c. Maximum Output Level:
   1) Measure with standard "fast" meter damping.
   2) Loudspeaker Cluster: Capable of providing 95 dB SPL in the audience area on axis of any high-frequency horn and employing wideband recorded music as a test signal.
   3) Distributed Loudspeaker Systems: Capable of providing 95 dB SPL on axis of any loudspeaker and using wideband recorded music as a test signal.

C. Video Systems: Test the video system following the approved Proof-of-Performance Test Plan to verify that it meets these minimum performance requirements. Video tape machines are exempt from these system requirements.
1. Video Standards:
   a. Frequency Response: ± 0.5 dB, 60 to 4.l8 MHz.
   b. Crosstalk: -40 dB at 3.58 MHz.
   c. S/N Ratio: 45 dB, DC to 4.l8 MHz, unweighted, peak to RMS.
   d. Hum: <10 mV peak to peak.
   e. Line and Field Tilt: 2% with 60 Hz square wave.
   f. Differential Gain: 1% at 3.58 MHz, l0-90% APL.
   g. Differential Phase: ± 1° at 3.58 MHz, l0-90% APL.
   h. Envelope Delay: ± 0.l microseconds, 0.2 to 2.1 MHz; ± 0.05 microseconds at 3.58 MHz.
   i. Color Production: Primary and Complementary Colors (R, G, B, Cy, Yl, Mg) at 75% saturation within inner 50% of the of inner boxes (± 2.5°) when viewed on vectorscope.
   j. Signal Levels: 1 V p-p, ± l IRE, at 100% peak white color bar.
2. Audio Standards:
   a. Frequency Response: ± l dB, 30-l5,000 Hz.
   b. Hum and Noise: -80 dBu, 30-l5,000 Hz, unweighted.
   c. Distortion: 0.25% THD, 30-l5,000 Hz.
   d. Signal Levels: +4dBu.

D. Video Display Systems: Calibrate each video display system as follows:
1. For projected displays align the image with the black borders of the screen:
   a. If the display uses a variety of aspect ratios use the zoom lens to align the image with the black borders of the screen. If the image does not fill the screen (e.g. a 16:9 screen with 4:3 image) then align top and bottom of image with black border of screen.
2. Allow projector or flat panel display to warm up for a minimum of 30 minutes.
3. Turn off all video enhancement circuitry options including image overscan.
4. Set factory color temperature to warm, D65, or other setting to achieve closest approximation to 6500°L color temperature. Set sharpness control to minimum.
5. Adjust black level and video gain:
   a. Reduce ambient light to less than 2 foot-candles of ambient light on screen.
   b. Using the PLUGE (Picture Lineup Generating Equipment) pattern from the signal generator, adjust the brightness (brightness control on most displays) until the “blacker-than-black” bar is visible on the screen and then decrease brightness until the bar just disappears.
   c. Using the grayscale pattern from the signal generator, adjust the contrast control so that the highest grayscale transition disappears and then decrease contrast to make the transition just visible..

d. Repeat steps b and c as required for stabile results. Record control settings.

6. Adjust color level or gain:
   a. Display SMPTE color bar test pattern. Shut off red and green channels on display or use a blue filter to observe the display.
   b. Adjust color and tint controls for optimum blue balance.
   c. With only red channel operating or with red filter check red balance. Repeat for green channel. If red and/or green balance is significantly out of balance, make minor changes to color and tint controls to achieve best compromise for color control settings.
   d. Record control settings.
7. Adjust sharpness:
   a. Using the S802B or similar pattern, adjust sharpness control for maximum sharpness without ringing (duplicate lines).
   b. Record control setting.
8. Brightness, Uniformity, and Contrast Ratio:
   a. Using the ANSI 9-zone pattern and a spot meter, measure screen brightness in each zone. Calculate screen brightness as the average of the nine zones and uniformity as the maximum variation from the average.
   b. Using the ANSI 12-zone checkerboard pattern measure the contrast ratio of representative white squares vs. adjacent black squares. Repeat contrast measurement with room lighting at representative viewing level (typically 7fc in seating area).
   c. Record measurements.
9. For display systems employing identical equipment (same model number), measure and adjust two representative samples as specified above. If control settings for both displays are in close agreement, controls of remaining identical displays may be set to same values without further testing, unless resulting performance is visibly different from the first two.

E. Digital Video Systems: Provide the following information for systems employing HDMI and/or Crestron DigitalMedia signals:
   1. The number of KSVs (HDCP keys) supported by each digital source device.
   2. The video timing (e.g. 1080p 30 fps Deep Color or 1366x768 30 Hz), HDCP use, and audio format of each non-portable digital source when operating.
   3. The video timings and supported audio formats for each connected sink.
   4. The video timings and supported audio formats presented in the EDID of sinks to each source – indicate the preferred video timing.
   5. The length of cable used on all HDMI or shielded twisted pair cables used for AV distribution.
   6. The data rate supported by each shielded twisted pair cable used for AV distribution.

F. Remote Control Systems:
   1. Test each function of each control station to verify proper operation and that each illuminated switch and indicator operates properly when the associated function is selected. Provide written report identifying each function and verifying operation of all functions on all panels in the following manner:

Location	Panel Type	Screen	Button	Operation
Lectern	VT-3500L	Slide Ctl.	Power ON/OFF	OK
"	"	"	FWD	OK
"	"	"	REV	OK
"	"	"	Focus In	OK

G. Test Reports and Certificates:

1. Submit results of all tests and adjustments conducted above and certification that the installation is complete and ready for checkout as specified under SUBMITTALS in PART I - GENERAL.

3.9 FINAL ADJUSTMENTS AND ACCEPTANCE TESTS

A. Upon approval of the contractor's test report, and at a time set by the Owner or Owner's authorized representative, assist the Consultant(s) in performing final system adjustments and acceptance tests. Provide all labor, material, tools, and measurement equipment necessary for these tests and adjustments, including the test equipment and material specified in Article 1.1, except as otherwise specified.

B. The contractor's representatives assisting in performance of these tests shall be thoroughly familiar with all details of the system, and shall include the field supervisor in overall charge during the course of the installation work.

C. Budget 8 working hours for the performance of these tests and adjustments. If final acceptance is delayed beyond this period because of installation not in accordance with these specifications, pay for all additional time and expenses of Consultant(s) during any resultant extension of the acceptance testing period.

D. Acceptance tests may include speech intelligibility surveys and subjective evaluations by observers listening at various positions under various operating conditions, using speech, music, and live or recorded effects material.

E. Measurement of frequency response, distortion, noise, or other characteristics may be performed on any item or group of items deemed necessary to determine conformity with specifications.

F. Adjustments: Adjust the system as instructed by the Consultant. Adjustments may be required to any portion of the system including:
   1. Equalization and level balance.
   2. Timing and programming of the audiovisual control system.

END OF SECTION 11 52 00

SECTION 11 52 00 -AUDIOVISUAL SYSTEMS

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

1.2 SUMMARY

A. This Section includes the following:
   1. Front-projection Screens.

B. Related Sections include the following:
   1. Division 6 Section “Miscellaneous Carpentry” for wood blocking for recessed screen installation.
   2. Division 16 Sections for electrical wiring, connections, and installation of remote-control switches for electrically-operated projection screens.
   3. Section 11 52 00, Audiovisual Systems, for remote-control interface of screens with low-voltage control interfaces.

1.3 DEFINITIONS

A. Gain: Ratio of light reflected from screen material to that reflected perpendicularly from a magnesium carbonate surface as determined per FS GG-S-00172D(1).

B. Half-Gain Angle: The angle, measured from the axis of the screen surface, to the most central position on perpendicular plane through the horizontal centerline of the screen, where the gain is half of the peak gain.

1.4 SUBMITTALS

A. Product Data: For each type of screen specified.

B. Shop Drawings: Show layout and types of projection screens. Include the following:
   1. Location of screen centerline relative to ends of screen case.
   2. Location of wiring connections.
   3. Location of seams in viewing surfaces.
   4. Connections to suspension systems for pendant- and recess-mounted screens.
   5. Anchorage details.
   6. Details of juncture of exposed surfaces with adjacent finishes.
   7. Frame details.
   8. Accessories.
   9. Wiring Diagrams: For electrically-operated units.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain projection screens through one source from a single manufacturer, except when specified screens are not available from a single manufacturer. Obtain each screen as a complete unit, including necessary mounting hardware and accessories.

B. Coordination of Work: Coordinate layout and installation of projection screens with other construction supported by, or penetrating through, ceilings, including light fixtures, HVAC equipment, fire-suppression system, and partitions.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver projection screens until building is enclosed, other construction within spaces where screens will be installed is substantially complete, and installation of screens is ready to begin.

PART 2 - PRODUCTS

2.1 FRONT-PROJECTION SCREEN

A. Material and Viewing Surface of Front-Projection Screens: Provide screens manufactured from mildew- and flame-resistant fabric of type indicated for each type of screen specified and complying with the following requirements.
   1. High-contrast grey viewing surface with gain characteristics complying with FS GG-S-00172D(1) for Type A screen surface.
   2. Material: Vinyl-coated glass-fiber fabric.
   3. Mildew Resistance: Provide mildew-resistant screen fabrics as determined by FS 191A/5760.
   4. Fire-Test-Response Characteristics: Provide projection-screen fabrics identical to materials that have been tested for flame resistance according to both small- and large-scale tests of NFPA 701.
   5. Seams: Where length of screen indicated exceeds maximum length produced without seams in fabric specified, provide screen with horizontal seam placed as follows:
      a. At top of screen at juncture between extra drop length and viewing surface.
   6. Provide extra drop length of dimension indicated to comply with the following requirements for fabric color and location of drop length:
      a. Color: Black.
      b. Location: At top of screen.
   7. Size of Viewing Surface: As indicated.

B. Electrically-Operated Screens:
   1. General:
      a. Provide manufacturer’s standard UL-labeled units consisting of case, screen, motor, controls, mounting accessories, and other components necessary for a complete installation.
      b. Multiple-Station Control: 2-position momentary-action control switch with metal device box and cover plate for flush wall mounting and for connection to low-voltage control interface to screen motor.
      c. Motor: Instant-reversing, end-mounted or in-roller motor of size and capacity recommended by screen manufacturer with permanently lubricated bearings, automatic thermal-overload protection, preset limit switches to automatically stop screen in up and down positions, and positive-stop action to prevent coasting.
      d. Screen Mounting: Top edge securely anchored to rigid metal roller and bottom edge formed into a pocket holding a min. 3/8-inch (9.5 mm) diameter metal rod with ends of rod protected by plastic caps.
   2. Electrically Operated Screen:
      a. Electrically operated roll-down projection screen for recessed ceiling installation.
      b. 120V, 60 Hz quick reversing motor housed in screen roller with thermal overload cutout, and permanently lubricated bearings
      c. Low voltage control, as noted.
      d. Screen: Flame retardant and mildew resistant with high-contrast surface.
      e. Size: As indicated.
      f. Provided with extra drop as required to allow bottom of image to reach a level 48" 46” in Coastal and Marine Studies 211) above floor.
      g. Acceptable Products:
         1) Draper Access Series E with HiDef Grey surface, low voltage control, and extra drop as required.
         2) Da-Lite Advantage Electrol with High Contrast Cinema Vision fabric, low voltage control, and extra drop as required.
         3) Stewart Filmscreen Luxus Model A ElectriScreen with GrayHawk non-perforated screen material, low voltage control, and extra drop as required.

2.2 SCREEN SCHEDULE:

A. Optics Lab 124: 50”x80”.

B. Classroom 210: 57.5”x92” (2 required).

C. Coastal & Marine Studies 211: 50”x80”.

D. Classroom 222: 57.5”x92” (2 required).

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install projection screens at locations indicated to comply with screen manufacturer’s written instructions.

B. Install drop-down front-projection screens with screen cases in position and relationship to adjoining construction indicated. Electric projection screen cases flush with ceiling plane. Securely anchor to supporting substrate using uni-strut or other approved non-combustible hardware in a manner that produces a smoothly operating screen with vertical edges plumb and viewing surface flat when screen is lowered. Brace screen off of front wall of room to prevent sway.

1. Test electrically operated units to verify that screen, controls, limit switches, closure, and other operating components are in optimum functioning condition.

3.2 PROTECTING AND CLEANING

A. Protect projection screens after installation from damage during construction. If damage occurs despite such protection, remove and replace damaged components or entire unit as required to provide units in their original, undamaged condition.

END OF SECTION 11 52 10

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Electrically-operated projection screens.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 09 51 00 - ACOUSTICAL CEILINGS for coordination with ceiling-recessed units.
2. Division 26 - ELECTRICAL for electrical service and connections including metal device boxes for switches and conduit, where required, for low-voltage control wiring.

1.3 SUBMITTALS

A. Product Data: For each type of screen indicated.

B. Shop Drawings: Show layouts and types of projection screens. Include the following:

1. Location of screen centerline relative to ends of screen case.
2. Location of wiring connections.
3. Location of seams in viewing surfaces.
4. Drop length.
5. Connections to supporting structure for pendant- and recess-mounted screens.
6. Anchorage details.
7. Details of juncture of exposed surfaces with adjacent finishes.
8. Frame details.
9. Accessories.
10. Wiring Diagrams: For electrically operated units.

C. Maintenance Data: For projection screens to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver projection screens until building is enclosed and other construction within spaces where screens will be installed is substantially complete and ready for screen installation.

1.6 COORDINATION

A. Coordinate layout and installation of projection screens with adjacent construction, including ceiling framing, light fixtures, HVAC equipment, and partitions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1. Bretford Manufacturing, Inc.
2. Da-Lite Screen Co., Inc
3. Draper Inc.
4. Stewart Filmscreen.

2.2 FRONT-PROJECTION SCREENS

A. Electrically Operated Screens: Manufacturer's standard units consisting of case, screen, motor, controls, mounting accessories, and other components necessary for a complete installation. Provide units that are listed and labeled as an assembly by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

1. Line Voltage Control: Remote, 3-position control switch installed in recessed metal device box with flush cover plate matching other electrical device cover plates in room where switch is installed.

2. Motor in Roller: Instant-reversing motor of size and capacity recommended by screen manufacturer; with permanently lubricated ball bearings, automatic thermal-overload protection, preset limit switches to automatically stop screen in up and down positions, and positive-stop action to prevent coasting. Mount motor inside roller with vibration isolators to reduce noise transmission.

3. Screen Mounting: Top edge securely anchored to rigid metal roller and bottom edge formed into a pocket holding a 3/8-inch- diameter metal rod with ends of rod protected by plastic caps.

a. Roller for end-mounted motor supported by self-aligning bearings in brackets.
b. Roller for motor in roller supported by vibration- and noise-absorbing supports.

B. Recessed, Electrically Operated Screens with Automatic Ceiling Closure: Motor in roller units designed and fabricated for recessed installation in ceiling; with bottom of case composed of two panels fully enclosing screen, motor, and wiring, one panel hinged and designed to open and close automatically when screen is lowered and fully raised, the other removable or openable for access to interior of case.

1. Provide screen case constructed to be installed with underside flush with ceiling.
2. Prime paint surfaces of screen case that will be exposed to view in the finished work.
3. Tab Tensioning: Provide units that have a durable low-stretch cord, such as braided polyester, on each side of screen connected to edge of screen by tabs to pull screen flat horizontally.

C. Screen Material and Viewing Surface:

1. Neutral Grey Viewing Surface: Peak gain of 0.9 to 1.0, and gain of not less than 0.8 at an angle of 50 degrees from the axis of the screen surface.
2. Mildew Resistance: Rating of 0 or 1 when tested according to ASTM G 21.
3. Flame Resistance: Passes NFPA 701.
4. Seamless Construction: Provide screens, in sizes indicated, without seams.
5. Edge Treatment: Black masking borders.
6. Provide extra drop length of dimension indicated to comply with the following requirements for fabric color and location of drop length:
7. Size of Viewing Surface: Wide screen format, as indicated on the Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install projection screens at locations indicated to comply with screen manufacturer's written instructions.

B. Install front-projection screens with screen cases in position and in relation to adjoining construction indicated. Securely anchor to supporting substrate in a manner that produces a smoothly operating screen with vertical edges plumb and viewing surface flat when screen is lowered.

1. Install low-voltage controls according to NFPA 70 and manufacturer's written instructions.

   a. Wiring Method: Install wiring in raceway except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Use UL-listed plenum cable in environmental air spaces, including plenum ceilings. Conceal raceway and cables except in unfinished spaces.

2. Test electrically operated units to verify that screen controls, limit switches, closure, and other operating components are in optimum functioning condition.
3. Test manually operated units to verify that screen operating components are in optimum functioning condition.

3.2 PROTECTING AND CLEANING

A. After installation, protect projection screens from damage during construction. If damage occurs despite such protection, remove and replace damaged components or entire unit as required to provide units in their original, undamaged condition.

END OF SECTION 11 52 10

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. This Section includes, but is not limited to, all materials, labor and equipment, complete with all anchors and related accessories, necessary to furnish, deliver and install:

1. Section 115313 - Fume Hoods: Fume Hoods
2. Section 115319 - Sterilizing and Washing Equipment: Autoclave, Under-counter Glass Washer, Glass Washer/Dryer
3. Section 115360 - Miscellaneous Laboratory Equipment: DI Polishers, Ice Makers, Pass-Through Box, Dust Extractor Arms and Downdraft Booth.

B. Although such work is not specifically shown or specified, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.

C. This Section also includes all general requirements, applicable to this and all other Equipment Specification Sections including, but not limited to:

Definitions
System description
Scope
Submittals
Quality assurance
Mock-up
Testing
Field measurements
Pre-installation conference
Delivery, storage and handling
Project conditions
Sequencing
Materials
Components
Finish and performance requirements
Examination, Installation, Adjusting, Cleaning and Protection Requirements

D. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 018113, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

E. Related Sections:

1. Section 115343 - Laboratory Service Fixtures
2. Section 123553 - Laboratory Casework - General Requirements
3. Section 123554 - Metal Laboratory Casework
4. Section 123555 - Wood Laboratory Casework

5. Division 22 - Plumbing: Plumbing Connections
6. Division 23 - HVAC: Exhaust Connections
7. Division 26 - Electrical: Electrical Connections

F. Quality Assurance

1. Single Source Responsibility:
   a. Furnish products for each type of equipment from one manufacturer for entire Project, unless otherwise acceptable to Architect.
   b. Provide each product as complete unit, including accessory items necessary for proper operation.
2. Manufacturer Qualifications: Company specializing in manufacturing Products specified in this Section.
3. Installer Qualifications: Manufacturer, or approved in writing by manufacturer.

1.3 SUBMITTALS

A. Shop drawings:

1. Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
2. Indicate typical layout including dimensions, locations, large-scale plans, elevations, cross sections, rough-in and anchor placement dimensions and tolerances, and clearances required.
3. Submit detail drawings of special accessory components not included in manufacturer's product data.
4. Deviations: Highlight, encircle, or otherwise identify deviations from the Contract Documents on submittals.

B. Product Data:

1. Submit manufacturer's descriptive literature and product specifications for each product.
2. Include data to indicate equipment dimensions and construction, equipment capacities, and point loads.
3. Include information for factory finishes, hardware, glass, sealants, accessories and other required components.
4. Include wiring diagrams and rough-in requirements.

C. Samples:

1. Finishes. Include color charts for finish indicating manufacturer's full range of colors available for selection.

D. Qualification Data:

1. Submit manufacturer's and installer's qualifications verifying experience.
2. Include list of completed projects having similar scope of Work identified by name, location, date, reference names, and phone numbers.

E. Manufacturer's Instructions: Submit manufacturer's printed installation instructions.

F. Operation and Maintenance Data:

1. Submit manufacturer's printed, recommended operation and maintenance data.
2. Include description of equipment operations, adjusting, and testing.

3. Identify system maintenance requirements, servicing cycles, and spare part sources.

G. Warranty: Submit specified warranty in accordance with Division 1.

H. LEED Submittals:

1. Recycled Content (MR4): Submit product data or other published information indicating total weight of product to be provided for the Project, percent of post-consumer recycled material by weight and percent of post-industrial recycled material by weight. Include material costs (excluding costs of installation).
2. For Credit IEQ 4.3: Manufacturers' product data for paints, including printed statement of VOC content.
3. Material Source (MR5): Submit product data or other published information verifying the location of manufacturing facility including name, address, and distance between manufacturing facility and the project site. Provide manufacturer's documentation indicating location where the base materials were extracted, mined, quarried, harvested, etc. and the distance between this location and the project site. Also include material costs (excluding costs of installation). Include information on Material Tracking Worksheets.

1.4 SYSTEM DESCRIPTION

A. Design Requirements:

1. Manufacturer is responsible for designing units, including anchorage of units to structural system and necessary modifications to meet specified requirements and maintain visual design concepts.
2. Dimensions, voltages, electrical power requirements, and utility connections are based on the items specified. Contractor is responsible for all costs for dimensional adjustments and for providing or arranging for additional electrical or utility services or equipment required as a result of using an equal product.
3. Provide concealed fastening wherever possible.
4. Attachment considerations: Account for site peculiarities and expansion and contraction movements so there is no possibility of loosening, weakening and fracturing connection between utility connections and units.
5. Equipment may be inspected by Owner at manufacturer's plant prior to shipment. Equipment found not in accord with specifications and approved Drawings may be rejected. Replace rejected equipment at no cost to Owner.
6. Electric operated and/or heated equipment: Comply with latest standards of National Electrical Manufacturer's Association (NEMA), National Electric Code (NEC) and Underwriters' Laboratories, Inc., (UL).

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Contractor furnished, Contractor installed equipment (C/C):

1. Contractor shall be responsible for furnishing and installing equipment.
2. Contractor to deliver to site in manufacturer's original labeled containers, and to store equipment to prevent damage to materials or structure in dry, weather tight, ventilated spaces, protect exposed surfaces and edges until work is completed, and repair or remove and replace damaged or rejected work.

B. Owner furnished, Contractor installed equipment (O/C):

1. New Equipment:
   a. Owner will be responsible for shipping these items to project site.

b. Contractor shall be responsible for unloading, handling, storing, unpacking, assembling, installing and connecting equipment, and removing debris.
c. Contractor to store equipment to prevent damage to materials or structure in dry, weather tight, ventilated spaces, and to protect exposed surfaces and edges until work is completed.

2. Existing Equipment:
a. Owner will disconnect, move, and place equipment in proximity of new location.
b. Contractor shall be responsible for moving equipment to final location, unpacking, assembling, installing, and connecting equipment, and removing debris.
c. Contractor to store equipment to prevent damage to materials or structure in dry, weather tight, ventilated spaces, and to protect exposed surfaces and edges until work is completed.

C. Owner furnished, Owner installed (O/O):

1. Future equipment and “NIC” equipment (Not in Contract under Base Bid)
2. Contractor to provide all structural, mechanical and electrical rough-in indicated.

1.6 JOB CONDITIONS

A. Drawings show arrangement and location of items of equipment. If it is necessary to vary from arrangement shown, because of structural, mechanical, electrical or other considerations, make such variations only after approval of Architect and at no additional expense to Owner.

B. Verify all dimensions at building.

C. Measure all recesses and openings at buildings and provide all trim pieces, fillers, and closures, in sizes required.

1.7 PRE-INSTALLATION CONFERENCE

A. Conduct pre-installation conference in accordance with Division 1.

B. Convene pre-installation conference one week prior to commencing work of this Section.

C. Attendance Required: Owner, Architect, Contractor, Manufacturer's Representative, and Installer.

D. Agenda: Discuss and agree upon acceptable substrate and support conditions, preparatory work, interface with mechanical and electrical services, and methods of installation and testing.

1.8 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Contractor furnished, Contractor installed equipment (C/C):

1. Contractor shall be responsible for furnishing and installing equipment.
2. Contractor to deliver to site in manufacturer’s original labeled containers, and to store equipment to prevent damage to materials or structure in dry, weathertight, ventilated spaces, protect exposed surfaces and edges until work is completed, and repair or remove and replace damaged or rejected work.

B. Owner furnished, Contractor installed equipment (O/C):

1. New Equipment:
a. Owner/Tenant will be responsible for shipping these items to project site.

b. Contractor shall be responsible for unloading, handling, storing, unpacking, assembling, installing and connecting equipment, and removing debris.
c. Contractor to store equipment to prevent damage to materials or structure in dry, weathertight, ventilated spaces, and to protect exposed surfaces and edges until work is completed.

2. Existing Equipment:
a. Owner/Tenant will disconnect, move, and place equipment in proximity of new location.
b. Contractor shall be responsible for moving equipment to final location, unpacking, assembling, installing, and connecting equipment, and removing debris.
c. Contractor to store equipment to prevent damage to materials or structure in dry, weathertight, ventilated spaces, and to protect exposed surfaces and edges until work is completed.

C. Owner furnished, Owner installed (O/O):

1. Future equipment and “NIC” equipment (Not in Contract under Base Bid)
2. Contractor to provide all structural, mechanical and electrical rough-in indicated.

PART 2 - PRODUCTS

2.1 EQUIPMENT

A. Acceptable manufacturers:

1. Laboratory equipment: As noted for individual items. Layouts, dimensions, voltages, electrical power requirements, and utilities connections are based on the items specified.
2. The Naming of manufacturer(s) and designation of product is for the purpose of identifying and describing required product and not to limit competition. Other manufacturers capable of producing the same appearance and having the same quality, durability, and performance may be proposed for use on this project subject to Architect’s approval, unless noted otherwise.
3. Other approved manufacturers are responsible for all adjustments required to fit their products to the work at no additional cost.
4. Provide equipment of each specialty type (as designated by Sections referenced) by one manufacturer, insofar as is possible, and except as otherwise indicated.

B. LEED Requirements:

1. Comply with requirements specified in Section 018113 “Sustainable Design Requirements & LEED Scorecard”.
2. Give preference to products with materials harvested/extracted/recovered and manufactured/milled within 500 miles of Project site.
3. Give preference to products containing renewable materials.
4. All field-applied paints and coatings used within the building waterproofing envelope shall comply with Section 090007 “Painting” and 090008 “Specialty Painting and Coatings.”

2.2 EQUIPMENT SCHEDULE

A. Refer to Equipment Schedule bound at the end of this Section.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions and proceed with work in accordance with specifications.

B. Verify that utility connections are in place and correctly positioned.

C. Verify that rough-in frames, anchors, and supports are accurately placed.

D. Correct unsatisfactory conditions.

E. Start of work constitutes acceptance of responsibility for performance.

3.2 INSTALLATION

A. Install in accordance with manufacturer's printed instructions and approved shop drawings.

B. Follow manufacturer’s printed instructions or drawings in all cases where items or details are not indicated.

C. Except for final connection, installation of each item shall be complete in every respect.

1. Provide all controls, regulating devices and all other accessories necessary for proper operation and maintenance of equipment including, but not necessarily limited to, pressure reducing valves, strainers, steam traps, control valves, relief valves, etc.
2. Include all accessories whether or not they are specifically indicated.

D. Where an item of equipment is furnished without a cord and plug, electrical wiring in or on equipment shall be brought to an equipment junction box located on, and as a part of equipment, such that a flexible connection no longer than 3 ft. will be needed to make a final connection between item and rough-in junction box.

E. Provide all stands, supports, sleeves, collars, escutcheons, brackets, braces or other miscellaneous items required for a complete installation.

F. Install equipment plumb, level, square, and free from warp or twist while maintaining dimensional tolerances and alignment with surrounding construction and adjacent surfaces.

G. Repair or replace damaged, stained or rejected work.

H. Test and adjust all items of equipment for satisfactory operation.

I. Interface With Other Work: Coordinate equipment installation with size, location, and installation of service utilities.

J. Sequences of Operation: Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

3.3 CLEANING

A. Remove protective coverings from pre-finished units.

B. Clean as required by manufacturer. Do not use materials or methods, which may damage finish or surrounding construction.

C. Touch-up minor damaged surfaces caused during installation; replace damaged components as directed by Architect.

3.4 PROTECTION

A. Protect finished work.

3.5 OWNER INSTRUCTION

A. Perform instruction of Owner personnel: See Division 1.

END OF SECTION 115300

Equip No.	Description	Spec. No.	Furnish / Install	New / Exist	Mounted	Size	Manuf.	Model No.	Remarks
FH-01	Fume Hood - 6'	115313	C/C	N	F	72"Wx36"Dx84"H	Kewaunee	H05_5472B00	Restricted-By-Pass
FH-02	ADA Fume Hood - 6'	115313	C/C	N	F	72"Wx36"Dx84"H	Kewaunee	H08_5472B00	Restricted-By-Pass
FH-03	Fume Hood - 4'	115313	C/C	N	F	48"Wx36"Dx84"H	Kewaunee	H05_5448B00	Restricted-By-Pass
FH-04	ADA Fume Hood - 4'	115313	C/C	N	F	48"Wx36"Dx84"H	Kewaunee	H08_5448B00	Restricted-By-Pass
FH-05	Future Fume Hood - 4'	115313	C/C	N	F	48"Wx36"Dx84"H	Kewaunee	H05_5448B00	Restricted-By-Pass
FH-06	Perchloric Fume Hood - 6'	115313	C/C	N	F	72"Wx36"Dx84"H	Kewaunee	H25L5472-00	Open-By-Pass
FH-07	ADA Perchloric Fume Hood - 4'	115313	C/C	N	F	48"Wx36"Dx84"H	Kewaunee	H25L5448-00	Open-By-Pass
FH-08	Perchloric Fume Hood - 4' (Polypropylene)	115313	C/C	N	F	48"Wx30"Dx59"H	AirMax	AC4030TE	W/ Scrubber
FH-09	***(NOT USED)***								
FH-10	Vertical Laminar Flow Hood - 6' (Polypropylene)	115313	C/C	N	F	73"Wx36"Dx68"H	NuAire	FumeGard NU-156-624	
FH-11	Vertical Laminar Flow Hood - 4' (Polypropylene)	115313	C/C	N	F	49"Wx36"Dx68"H	NuAire	FumeGard NU-156-424	
FH-12	***(NOT USED)***								
FH-13	***(NOT USED)***								
FH-14	***(NOT USED)***								
EQ-001	Glassware Washer (Flask Scrubber)	115319	C/C	N	F	24"Wx24"Dx34"H	Labconco	4420330	Undercounter
EQ-002	Glassware Washer / Dryer	115319	C/C	N	F	36"Wx44"Dx80"H	Lancer	Labexia 1700 LXA	Free Standing
EQ-003	Autoclave	115319	C/C	N	F	28"Lx34"Wx74"H	Getinge	GE-633LS	W/ Integral steam generator
EQ-004	DI Water Polisher	115360	C/C	N	IC	13"Wx15"Dx20"H	Millipore	Milli-Q Advantage	with Q-POD
EQ-005	Ice Maker	115360	C/C	N	F	36"Wx24"Dx39"H	Hoshizaki	F300BAF	Water Cooled
EQ-006	Pass-Through Box	115360	C/C	N	WL	24"Wx24"Dx24"H	G2 Automated Technologies	EPPT-POLY-SCPT006	
EQ-007	Dust Extractor Arm	115360	C/C	N	C	8' L	E-Z Arm	II High Flow Extractor	
EQ-008	Controlled Environmental Room	132420	C/C	N	F		Thermmax	(4º C) Cold Room	Water Cooled Condensing Unit
EQ-009	Pre-Fabricated Growth Chamber Unit	132420	C/C	N	F		EGC	M75	Water Cooled Condensing Unit
EQ-010	Reach-In Growth Chamber Unit	132420	C/C	N	F	34"Wx34"Dx73"H	Percival	E-36L1	
EQ-011	Local Exhaust for AA	Div 23	C/C	N	C				
EQ-012	Exhaust Canopy	Div 23	C/C	N	C				
EQ-013	Vent Port	Div 23	C/C	N	C				

Equip No.	Description	Spec. No.	Furnish / Install	New / Exist	Mounted	Size	Manuf.	Model No.	Remarks
EQ-014	Dust Ventilation System	Div 23	C/C	N	C				Part of building vent system. Vents outside
EQ-015	High Density Shelving System	105630	C/C	N	F		SpaceSaver Systems, Inc.		
EQ-016	Downdraft Booth	115360	C/C	N	F	72"Wx54"Dx80"H	Dual Draw, Air Cleaning Specialists	TB 3072-5000	
EQ-017	Horizontal Laminar Flow Hood Workstation-6' (Polypropylene)	N/A	O/O	N	F		Microzone	H6-MW-99C30	Non-vented
EQ-018	***(NOT USED)***								
EQ-019	BioSafety Cabinet - Type II A2 - 6'	N/A	O/O	N	F	78"Wx33"Dx95"H	NuAire	NU-425-600	Non-Ducted
EQ-020	BioSafety Cabinet - Type II A2 - 4'	N/A	O/O	N	F	54"Wx33"Dx95"H	NuAire	NU-425-400	Non-Ducted
EQ-021	Refrigerator (Undercounter)	N/A	O/O	E	F	19"Wx20"Dx34"H	Sanyo	SR-3620/SR-3660	**On Standby power**
EQ-022	Refrigerator	N/A	O/O	E	F	16.7 Cu. Ft.	Fisher Scientific	NC9036828	
EQ-023	Refrigerator	N/A	O/O	E	F	16.7 Cu. Ft.	Fisher Scientific	NC9036828	
EQ-024	(4°C) Refrigerator	N/A	O/O	N	F	36"Wx34"Dx70"H			
EQ-025	Chromatography Refrigerator	N/A	O/O	N	F				
EQ-026	Chromatography Refrigerator	N/A	O/O	N	F	27 cu ft.	Fisher Isotemp	13-986-127GA	From B01
EQ-027	(-20°) Freezer	N/A	O/O	E	F		American Scientific Products Revco	SY 88326	**On Standby power**
EQ-028	(-70°) Freezer	N/A	O/O	E	F	29"Wx27"Dx46"H	Revco GS Laboratory Equipment	ULT 390-5-A31	**On Standby power**
EQ-029	Freezer	N/A	O/O	E	F	32"Wx31"Dx70"H	Fischer Scientific	13-986-150 Capacity=583L	
EQ-030	Freezer	N/A	O/O	N	F	32"Wx31"Dx70"H			
EQ-031	(-20°C) Freezer	N/A	O/O	N	F				**On Standby power**
EQ-032	(-20° C) Freezer	N/A	O/O	N	F	5 cu ft.	Thermo Scientific	REF417A	From B01
EQ-033	(-80°C) Freezer	N/A	O/O	N	F				**On Standby power**

Equip No.	Description	Spec. No.	Furnish / Install	New / Exist	Mounted	Size	Manuf.	Model No.	Remarks
EQ-034	Liquid N2 Freezer	N/A	O/O	N	F				
EQ-035	Chest Freezer	N/A	O/O	N	F	8 foot			
EQ-036	Incubator	N/A	O/O	E	F		Lab-Line Instruments	3528	**On Standby power**
EQ-037	Incubator (Roll-In)	N/A	O/O	E	F		BellCo Glass Biotechnology	Cat# 7728-06005 Serial# MRPO-53	**On Standby power**
EQ-038	Still Incubator (27°C & 37°C)	N/A	O/O	N	B	3.4 cu ft.	Fisher Isotemp	3.4 cu ft (625F)	
EQ-039	Shaking Incubator (27°C & 37°C)	N/A	O/O	E	B				Moved from JE 331
EQ-040	Air Incubator	N/A	O/O	N	F				
EQ-041	CO2 Incubator	N/A	O/O	N	F				
EQ-042	Glove Box	N/A	O/O	N	F	80"Wx32"Dx76"H	Vacuum Atmospheres Company	Nexus VAC 100031	**On Standby power**
EQ-043	Glove Box	N/A	O/O	E	F	80"Wx32"Dx76"H	Vacuum Atmospheres Company	Nexus VAC 100031	**On Standby power**
EQ-044	Glove Box Vacuum Pump	N/A	O/O	E	F	20"Wx5"Dx8"H	Leybold Trivac	D4A	
EQ-045	Glove Box	N/A	O/O	N	F	83"Wx32"Dx60"H	M. Braun	Unilab	Requires Compressed Air & Cooling water hookup
EQ-046	Glove Box Purifier	N/A	O/O	N	F		M. Braun		
EQ-047	Glove Box Vacuum Pump	N/A	O/O	N	F		M. Braun		
EQ-048	Glove Box	N/A	O/O	E	F	83"Wx32"Dx60"H	M. Braun	Unilab	Requires Compressed Air & Cooling water hookup
EQ-049	Glove Box Purifier	N/A	O/O	E	F		M. Braun		Located in P16
EQ-050	Glove Box Vacuum Pump	N/A	O/O	E	F		M. Braun		
EQ-051	Glove Box Heavy Duty Table (Granite)	N/A	O/O	E	F				
EQ-052	Rotovap	N/A	O/O	E	B	20"Wx14"Dx19"H	Buchi	R-3000	Inside Fume Hood
EQ-053	Rotovap Chiller	N/A	O/O	E	B	10"Wx20"Dx24"H	ThermoFisher	Neslab RTE7	Inside Fume Hood.
EQ-054	Rotovap Pump	N/A	O/O	E	B	5"Wx12"Dx7"H	Gast	5KH33DN16JX	Inside Fume Hood.
EQ-055	Rotovap	N/A	O/O	E	F	22"Wx17"Dx23"H	Buchi	R-215 Basic	
EQ-056	Rotovap	N/A	O/O	E	B				

Equip No.	Description	Spec. No.	Furnish / Install	New / Exist	Mounted	Size	Manuf.	Model No.	Remarks
EQ-057	Rotovap -Vacuum Pump	N/A	O/O	E	IC				Inside cabinet. Oil Free.
EQ-058	Rotovap	N/A	O/O	N	B	22"Wx17"Dx23"H	Buchi	R-215 Basic	
EQ-059	Rotovap -Vacuum Pump	N/A	O/O	N	B	13"Wx8"Dx8"H	Gast Manuf. Corp.	Standard	
EQ-060	Solvent Purification System	N/A	O/O	N	F	43"Wx29"Dx77"H	Innovative Technology, Inc.	PureSolv MD 5	
EQ-061	Vacuum Pump for Solvent Purification System	N/A	O/O	N	F	7"Wx13"Dx9"H	Welch	Dryfast Solid PTFE 2044	
EQ-062	Balance	N/A	O/O	E	B	15"Wx10"Dx14"H	Denver Instruments	P-314	
EQ-063	Balance	N/A	O/O	E	B				
EQ-064	Balance	N/A	O/O	E	B	8"Wx18"Dx12"H	Ohaus		
EQ-065	Analytical Balance	N/A	O/O	E	B				
EQ-066	Analytical Balance	N/A	O/O	E	B	12"Wx18"Dx12"H	Mettler Toledo	AB54-S/FACT	
EQ-067	Magnetic Balance	N/A	O/O	N	B	9"Wx12"Dx6"H	Johnson Matthey	Mark I	
EQ-068	Analytical Balance	N/A	O/O	N	B		Denver Instrument		
EQ-069	Oven	N/A	O/O	E	B	24"Wx26"Dx26"H	Fischer Scientific	625G	
EQ-070	Oven	N/A	O/O	E	B	24"Wx23"Dx26"H	Fischer Scientific	625G	
EQ-071	Drying Oven	N/A	O/O	E	B	24"Wx26"Dx26"H	Fischer Scientific	Isotemp Small	
EQ-072	Oven	N/A	O/O	E	B	24"Wx25"D			
EQ-073	Oven	N/A	O/O	E	B	24"Wx25"D			
EQ-074	Oven	N/A	O/O	E	B	24"Wx24"Dx24"H	Blue M	SW - 17TA-1	Not Located
EQ-075	Drying Glass Oven	N/A	O/O	N	B	24"Wx26"Dx26"H	Fischer Scientific	Isotemp Small	
EQ-076	Oven	N/A	O/O	N	B				
EQ-077	Vacuum Pump	N/A	O/O	E	IC	20"Wx5"Dx8"H	Leybold Trivac	D4A	Inside cabinet under hood.

Equip No.	Description	Spec. No.	Furnish / Install	New / Exist	Mounted	Size	Manuf.	Model No.	Remarks
EQ-078	Vacuum Pump	N/A	O/O	E	IC	7"Wx19"Dx17"H	Edwards	RV5	Inside cabinet under hood
EQ-079	Vacuum Pump	N/A	O/O	E	IC				Inside cabinet
EQ-080	Vacuum Pump	N/A	O/O	E	IC		Alcatel	4101030421	Inside cabinet under hood
EQ-081	Vacuum Pump	N/A	O/O	E	F				
EQ-082	Vacuum Pump	N/A	O/O	N	IC	13"Wx8"Dx8"H	Gast Manuf. Corp.	Standard	Inside cabinet under hood.
EQ-083	LCMS	N/A	O/O	E	B	18"Wx29"Dx17"H	Shimadzu	2010-EV	**On Standby power**
EQ-084	LCMS - Prominence UFLC System	N/A	O/O	E	B	23"Wx17"Dx26"H	Shimadzu		**On Standby power**
EQ-085	LCMS - System Controller	N/A	O/O	E	B		Shimadzu	CBM-20A	Stacked
EQ-086	LCMS - UV-VIS Detector	N/A	O/O	E	B		Shimadzu	SPD-20A	Stacked
EQ-087	LCMS - On-Line Degasser	N/A	O/O	E	B		Shimadzu	DGU-20A5	Stacked
EQ-088	LCMS - Solvent Delivery Unit	N/A	O/O	E	B		Shimadzu	LC-20AB	Stacked
EQ-089	LCMS - Auto Sampler	N/A	O/O	E	B		Shimadzu	SIL-20A	Stacked
EQ-090	LCMS - PC & Printer	N/A	O/O	E	B				
EQ-091	LCMS - Vacuum Pump	N/A	O/O	E	IC				Inside cabinet.
EQ-092	***(NOT USED)***								
EQ-093	***(NOT USED)***								
EQ-094	***(NOT USED)***								
EQ-095	***(NOT USED)***								
EQ-096	***(NOT USED)***								
EQ-097	***(NOT USED)***								
EQ-098	***(NOT USED)***								
EQ-099	Atomic Absorption Spectrophotometer (AA)	N/A	O/O	E	B		PerkinElmer	AAnalyst 800	With PC
EQ-100	***(NOT USED)***								
EQ-101	Microwave Reactor	N/A	O/O	N	B	15”Wx17”Dx12”H	CEM Corp	925484	Inside Fume Hood.
EQ-102	***(NOT USED)***								
EQ-103	Air Compressor for NMR	N/A	O/O	E	F				Connected to C11
EQ-104	GCMS	N/A	O/O	N	B	18"Wx29"Dx17"H			**On Standby power**
EQ-105	GCMS -Vacuum Pump	N/A	O/O	E	IC				Inside cabinet.

Equip No.	Description	Spec. No.	Furnish / Install	New / Exist	Mounted	Size	Manuf.	Model No.	Remarks
EQ-106	UV-VIS Spectrometer	N/A	O/O	N	B				
EQ-107	Luminescence Spectrometer	N/A	O/O	N	B				Not Located
EQ-108	FTIR	N/A	O/O	E	B				
EQ-109	***(NOT USED)***								
EQ-110	FTIR	N/A	O/O	N	B				
EQ-111	Printer	N/A	O/O	E	B				
EQ-112	GC	N/A	O/O	E	B	12"Wx11"Dx16"H	Gow-Mac		
EQ-113	Microwave Reactor	N/A	O/O	E	B	25"Dx20"Wx23"H	CEM Corp	927060	Inside Fume Hood
EQ-114	Dry Ice Box	N/A	O/O	E	B	6"Wx6"Dx12"H			
EQ-115	UV Light (TLC)	N/A	O/O	E	B	36"Wx6"Dx24"H			
EQ-116	Melting Points	N/A	O/O	E	B	6"Wx6"Dx6"H			
EQ-117	300 / 400 MHz Magnet	N/A	O/O	E	F		Bruker	Avance 300 / 400	Shielded. **On Standby Power**
EQ-118	Cryo Cooling Unit	N/A	O/O	E	F		Bruker		
EQ-119	HPPR	N/A	O/O	E	F		Bruker		
EQ-120	He Compressor	N/A	O/O	E	F		Bruker		
EQ-121	Buck Booster	N/A	O/O	E	F		Bruker		
EQ-122	Avance Console	N/A	O/O	E	F		Bruker		
EQ-123	Workstation	N/A	O/O	E	F		Bruker		
EQ-124	BCU-05	N/A	O/O	E	F		Bruker		
EQ-125	Video Monitor	N/A	O/O	N	B				
EQ-126	Water Bath	N/A	O/O	N	B		Fisher Isotemp	Dual Chamber	
EQ-127	Fluorometer	N/A	O/O	N	B	5"Wx8"Dx3"H	Hoefer	DQ300	
EQ-128	Spectrophotometer	N/A	O/O	N	B	16"Wx12"Dx7"H	United Products	1200	
EQ-129	Electroporator	N/A	O/O	N	B	11"Wx9"Dx4"H	Eppendorf	2510 (940000602)	
EQ-130	Spiral Plater	N/A	O/O	N	B	20"Wx16"Dx13"H	Neutec	1701	
EQ-131	Laser Colony Counter	N/A	O/O	N	B	7"Wx9"Dx14"H	Neutec	6010	
EQ-132	Microcentrifuge	N/A	O/O	N	B	9"Wx10"Dx14"H	Fisher Accuspin	Micro17R	
EQ-133	Thermocycler	N/A	O/O	N	B	10"Wx16"Dx12"H	Thermo Scientific	HBPXE02110	
EQ-134	Sonicator	N/A	O/O	N	B	12"Wx16"Dx15"H	Branson	15-337-22H	

Equip No.	Description	Spec. No.	Furnish / Install	New / Exist	Mounted	Size	Manuf.	Model No.	Remarks
EQ-135	Computer	N/A	O/O	N	B		Macintosh	iMac	
EQ-136	Clinical Centrifuge	N/A	O/O	N	B	20"Wx23"Dx14"H	Thermo Scientific	Sorvall Primo R 75005448	Refrigerated
EQ-137	Coulter Counter	N/A	O/O	N	B				
EQ-138	UV-Cross Linker	N/A	O/O	N	B				Stacked
EQ-139	UV-Vis Spec.	N/A	O/O	N	B				Stacked
EQ-140	Water Bath	N/A	O/O	N	B				
EQ-141	Speed Vac Centrifuge	N/A	O/O	N	B				
EQ-142	Micro Centrifuge	N/A	O/O	N	B				
EQ-143	Compound Microscope	N/A	O/O	N	B				
EQ-144	Microscope	N/A	O/O	N	B				
EQ-145	Liquid N2 Dewar	N/A	O/O	E	F				
EQ-146	Microscope	N/A	O/O	N	B				
EQ-147	***(NOT USED)***								
EQ-148	Microtome	N/A	O/O	N	B		Leica	EM UC7/FC7	
EQ-149	Water Bath	N/A	O/O	N	B				
EQ-150	Microscope	N/A	O/O	N	B				
EQ-151	Centrifuge - Regular Speed	N/A	O/O	N	B		Sorvall		
EQ-152	LSCM Confocal Microscope	N/A	O/O	N	B				
EQ-153	DSU Spinning Disk Confocal Microscope	N/A	O/O	N	B				
EQ-154	***(NOT USED)***								
EQ-155	Centrifuge	N/A	O/O	N	B				
EQ-156	Coolers with frozen plants and soil.	N/A	O/O	N	F				
EQ-157	Cathodoluminescence Microscope	N/A	O/O	E	B	60"W	Nuclide		
EQ-158	Raman Microscope	N/A	O/O	N	B				Not Located
EQ-159	Polarization Microscope	N/A	O/O	N	B		Leica	DMLP	Attach to existing cathodoluminescence and fluid inclusion equipment
EQ-160	Fluid Inclusion Microscope	N/A	O/O	E	B	60"W	Linkam		
EQ-161	Microscope	N/A	O/O	N	B	10"Wx17"Dx23"H			

Equip No.	Description	Spec. No.	Furnish / Install	New / Exist	Mounted	Size	Manuf.	Model No.	Remarks
EQ-162	X-Ray Fluorescence Spectrometer	N/A	O/O	N	F	52"Wx35"Dx54"H	Rigaku	ZSX Primus II (or Panalytical Axios, or ThermoARL Advant'X)	3 or 4 KW tube. Requires Cooling water hookup
EQ-162a	Computer Station for (X-Ray Fluorescence Spectrometer, EQ-162)	N/A	O/O	N	F	26"Wx30"Dx54"H	Rigaku		
EQ-162b	Ion Exchange Assembly for (X-Ray Fluorescence Spectrometer, EQ-162)	N/A	O/O	N	WL		Rigaku		
EQ-162c	Water Chiller for (X-Ray Fluorescence Spectrometer, EQ-162)	N/A	O/O	N	F	27"Wx26"Dx35"H	Haskris	R175W	
EQ-163	X-Ray Diffractometer	N/A	O/O	E	B	22"Wx15"Dx26"H	Rigaku	Miniflex II	Requires Cooling water hookup
EQ-163a	PC, Monitor & Printer for (X-Ray Diffractometer, EQ-163)	N/A	O/O	E	B				
EQ-163b	Chiller for (X-Ray Diffractometer, EQ-163)	N/A	O/O	E	F	14"Wx16"D	Haskis	HAS-WA1-60	
EQ-164	X-Ray Fluorescence Analytical Microscope (Micro XRF)	N/A	O/O	N	B	72"Wx40"Dx30"H	Horiba	XGT-7000 (or EDAX Orbis)	1.3 kva. Requires Liq. N2 hookup
EQ-164a	X-Ray Controller for (Micro XRF, EQ-164)	N/A	O/O	N	B	Included in (EQ-164)	Horiba		
EQ-164b	X-Ray Stage Controller for (Micro XRF, EQ-164)	N/A	O/O	N	B	Included in (EQ-164)	Horiba		
EQ-164c	PC, Monitor & Printer for (Micro XRF, EQ-164)	N/A	O/O	N	B	Included in (EQ-164)			
EQ-164d	Vacuum Pump for (Micro XRF, EQ-164)	N/A	O/O	N	IC	Included in (EQ-164)			
EQ-165	X-Ray Chiller	N/A	O/O	N	F				
EQ-166	***(NOT USED)***								
EQ-167	Desiccator Cabinet	N/A	O/O	E	B				
EQ-168	Muffle Furnace	N/A	O/O	E	B	18"Wx18"D			Inside Fume Hood
EQ-169	Ultra Sonic Bath	N/A	O/O	E	B	14"Wx16"D			
EQ-170	Fusion System	N/A	O/O	E	B	36"Wx19"Dx19"H	Katanax		Electric. No Gas
EQ-171	Mixer / Mill	N/A	O/O	E	B	22"Wx24"D	Spex Certiprep	8000M	
EQ-172	Hydraulic Press	N/A	O/O	E	B	16"Wx22"D	Specac		

Equip No.	Description	Spec. No.	Furnish / Install	New / Exist	Mounted	Size	Manuf.	Model No.	Remarks
EQ-173	Magnetic Separator	N/A	O/O	E	B	40"Wx26"D	Frantz		
EQ-174	ICP-MS Magnetic Sector field	N/A	O/O	N	F		Thermo-Finnigan	Element 2XR	Requires Cooling water hookup
EQ-175	ICP-MS Laser Ablation System	N/A	O/O	N	F		NewWave	213 nm	Requires Cooling water hookup
EQ-176	ICP-MS Water Chiller	N/A	O/O	N	F				
EQ-177	Ground Penetration Radar (GPR)	N/A	O/O	E	B		Mala		On Cart. Not Located
EQ-178	Magnetometer	N/A	O/O	E	B		Geometrics		Not Located
EQ-179	Ground Conductivity Meter	N/A	O/O	N	B				Not Located
EQ-180	Resistivity Array	N/A	O/O	N	B				Not Located
EQ-181	Vibracorer	N/A	O/O	N	B				Not Located
EQ-182	12 Channel Seismic Array	N/A	O/O	N	B				Not Located
EQ-183	Gravity Meter	N/A	O/O	N	B				Not Located
EQ-184	Slab Saw (30")	N/A	O/O	N	F	30" dia. (10'x8')	Kingsley North		Oil Cooled
EQ-185	Sand Pit (Box)	N/A	O/O	E	F	48"Wx48"D			Built from lumber
EQ-186	Large Jaw Crusher	N/A	O/O	E	F	48"Wx48"D	Bico	Bico Chipmunk	4" Vent Port (Built-In)
EQ-187	Large Ring / Puck Mill	N/A	O/O	E	F	36"Wx36"D	Spex Certiprep	Spex 8500 Shatterbox	Shatterbox w/ agate or Al-Ceramic grinding head
EQ-188	Hydraulic Rock Splitter	N/A	O/O	N	F	48"Wx36"D	Wards Natural Science		
EQ-189	Drill Press	N/A	O/O	N	F	20"Wx36"Dx70"H			W/ Diamond Core Bits. Requires Hose bib & Drain with sediment trap
EQ-190	RO-TAP Sieve Shaker	N/A	O/O	E	B	30"Wx24"D	W.S. Tyler	RX-29	
EQ-191	Large Disc Mill	N/A	O/O	E	F	40"Wx30"Dx20"H	Bico	Bico UA Disk Pulverizer	Inside Downdraft Booth
EQ-192	Small Jaw Crusher	N/A	O/O	E	B	14"Wx25"D	Sepor		Inside Downdraft Booth
EQ-193	Small Disc Mill	N/A	O/O	E	B	16"Wx12"D	Sepor		Inside Downdraft Booth
EQ-194	Small Ring / Puck Mill	N/A	O/O	E	B	18"Wx22"D	Rock Labs		

Equip No.	Description	Spec. No.	Furnish / Install	New / Exist	Mounted	Size	Manuf.	Model No.	Remarks
EQ-195	Trim Saw	N/A	O/O	E	B	20"Wx30"D			Requires Cooling water hookup & Sink / Drain
EQ-196	Vibratory Lap	N/A	O/O	N	B	20"Wx20"D	Kingsley North		
EQ-197	Thin Section Machine	N/A	O/O	E	B	30"Wx28"D			Requires water hookup & Drain
EQ-198	Polishing Wheels	N/A	O/O	E	B	14"Wx14"D			Requires Drain
EQ-199	Grounding & Polishing Counsel	N/A	O/O	N	F	60"Wx30"D	Leco (or Buhler)	Metallographic Two-Wheel console	Requires Cooling water hookup
EQ-200	Small Muffle Furnace	N/A	O/O	E	B	12"Wx12"D			
EQ-201	Large Muffle Furnace	N/A	O/O	E	B	18"Wx18"D			
EQ-202	Meteorology Instrument Suite	N/A	O/O	N	F				Locate on Roof. Display in Hallway
EQ-203	Meteorology Instrument Server	N/A	O/O	N	B				
EQ-204	Seismometer Instrument	N/A	O/O	N	F				Locate Sensor in Basement. Display in Hallway
EQ-205	Seismometer Instrument Server	N/A	O/O	N	B				
EQ-206	N-Strom Microscope	N/A	O/O	N	B		Nikon	N-Storm Super-Resolution	**On Standby power**
EQ-207	***(NOT USED)***								
EQ-208	Furnace	N/A	O/O	E	B				Inside Fume Hood
EQ-209	Equipment Rack	N/A	O/O	E	F				
EQ-210	Cryo Cooler ARS Displex	N/A	O/O	E	B		APD Cryogenics Inc		On Cryocooler Table
EQ-211	Cryo Cooler Table	N/A	O/O	E	F	36"Wx60"Dx48"H			
EQ-212	Cryo Cooler Compressor	N/A	O/O	E	B		CTI-Cryogenics		On Cryocooler Table. Requires Cooling water hookup
EQ-213	Cryo Cooler Vacuum Pump	N/A	O/O	E	B				On Cryocooler Table
EQ-214	Cryo Cooler Control Board	N/A	O/O	E	B		Perkin-Elmer	Part #: 401-338-200, Serial #: 8182	On Cryocooler Table
EQ-215	Cryostat	N/A	O/O	E	F		ARS		On Tripod Stand

Equip No.	Description	Spec. No.	Furnish / Install	New / Exist	Mounted	Size	Manuf.	Model No.	Remarks
EQ-216	Cryostat Compressor	N/A	O/O	E	F	24"Wx24"Dx24"H	APD Cryogenics Inc	HC-4	
EQ-217	Magnet	N/A	O/O	E	F	36"Wx36"Dx60"H	Harvey-Wells Corp.		2 Tons
EQ-218	Electromagnet Power Supply	N/A	O/O	E	B		LakeShore	647	On Equipment Rack
EQ-219	Voltage / Current Source	N/A	O/O	E	B		Keithley	228A	On Equipment Rack
EQ-220	Sensitive Digital Voltmeter	N/A	O/O	E	B		Keithley	182	On Equipment Rack
EQ-221	Programmable Current Source	N/A	O/O	E	B		Keithley	228	On Equipment Rack
EQ-222	(Unidentified Item)	N/A	O/O	E	B		LakeShore		On Equipment Rack
EQ-223	Switch System	N/A	O/O	E	B		Keithley	7001	On Equipment Rack
EQ-224	Multimeter	N/A	O/O	E	B		Keithley	2001	On Equipment Rack
EQ-225	DC Power Supply	N/A	O/O	E	B			1630	On Equipment Rack
EQ-226	Autoranging Multimeter	N/A	O/O	E	B		Keithley	175	On Equipment Rack
EQ-227	Temperature Controller	N/A	O/O	E	B		Scientific Instruments Inc.	9620-1	On Equipment Rack
EQ-228	Tube Furnace	N/A	O/O	E	B	24"Wx18"Dx24"H	Blue M	HTF55322A	
EQ-229	Optical Microscope	N/A	O/O	E	B	21"Wx15"Dx22"H	Olympus	High resolution microscope BH-2	
EQ-230	Optical Microscope	N/A	O/O	E	B	14"Wx8"Dx16"H	Zeiss	STEMI-2000 Stereo Optical	
EQ-231	Electron Microscope (SEM)	N/A	O/O	E	B	26"Wx36"Dx48"H	Hitachi	TM-1000 (Portable)	Microscope & Monitor On Cart
EQ-232	Electron Microscope - X-Ray Controller	N/A	O/O	E	B				On Cart
EQ-233	***(NOT USED)***								
EQ-234	Electron Microscope - Pump	N/A	O/O	E	F				
EQ-235	UV-VIS Spectrophotometer	N/A	O/O	E	B	40"Wx26"Dx11"H	Shimadzu	UV-3600	With PC & Printer
EQ-236	Elipsometer	N/A	O/O	E	F	36"Wx36"Dx36"H	Rudolph Research	AutoEL	With Table
EQ-237	X-ray Fluorescence Spectroscopy	N/A	O/O	E	B	23"Wx27"Dx30"H	Spectro Analytical Instruments Inc	MIDEX	

Equip No.	Description	Spec. No.	Furnish / Install	New / Exist	Mounted	Size	Manuf.	Model No.	Remarks
EQ-238	Indentation Tester	N/A	O/O	N	F	36"Wx36"Dx36"H	CSM Instruments	Nano	
EQ-239	Tensile Strength Tester	N/A	O/O	N	B	18"Wx24"Dx55"H	Instron	5940 Series Single Column Low Force	(8 Tons)
EQ-240	Atomic Force Microscope (AFM)	N/A	O/O	E	B		Veeco	Multimode 8	Inside Glove Box with vibration dampening
EQ-241	***(NOT USED)***								
EQ-242	Turbomolecular Pump	N/A	O/O	E	B		Varian	V-250	Connected to Vacuum Chamber. Not Located
EQ-243	Vacuum Chamber	N/A	O/O	E	B	24"Wx24"Dx36"H	Kurt J. Lesker	Custom Made	On Optics Table
EQ-244	Turbomolecular Pump - Mechanical Pump	N/A	O/O	E	F				Connected to Turbo Pump - Located in P16
EQ-245	Optics Table	N/A	O/O	N	F	120"Wx59"Dx12"H	Technical Manufacturing Co.	CleanTop 784-673-02R	with 24" tie-bar leg set 14-426-35
EQ-246	Eximer Laser	N/A	O/O	N	B	31"Wx17"Dx16"H	GAM Laser	EX350	Class IV Laser. On Optics Table. Requires Cooling water hookup
EQ-247	Pump for Eximer Laser	N/A	O/O	N	F				Not Located
EQ-248	ND YAG Laser	N/A	O/O	E	B		Quantel	YG660A	Class IV Laser. On Optics Table. Requires Cooling water hookup
EQ-249	Toxic Gas Cylinder Storage Cabinet	123554	C/C	N	F	26"Wx19"Dx79"H	Matheson Trigas	1178F	Located inside tank storage closet
EQ-250	Large Laser Table	N/A	O/O	N	F	144"Wx59"Dx12"H	Technical Manufacturing Co.	CleanTop 784-676-02R	with 24" tie-bar leg set 14-426-35
EQ-251	Small Laser Table	N/A	O/O	N	F	72"Wx59"Dx12"H	Technical Manufacturing Co.	CleanTop 784-671-02R	with 24" tie-bar leg set 14-426-35

Equip No.	Description	Spec. No.	Furnish / Install	New / Exist	Mounted	Size	Manuf.	Model No.	Remarks
EQ-252	Titanium Sapphire Laser	N/A	O/O	E	B		Swartz Electro-Opticl	Ti: Sapphire standing-wave laser	Class IV Laser. Requires Cooling water hookup
EQ-253	Argon-Ion Laser	N/A	O/O	E	B		Lexel	95-L 5 watt	Class IV Laser. Requires Cooling water hookup
EQ-254	***(NOT USED)***								
EQ-255	Optics Table	N/A	O/O	N	F	144"Wx48"Dx18"H	Technical Manufacturing Co.	CleanTop 784-763-02R	with 18" tie-bar leg set 14-424-35
EQ-256	High Grade Astronomical Camera	N/A	O/O	N	B				
EQ-257	Multi-Channel Photon Correlator System	N/A	O/O	N	B				
EQ-258	Optics Table	N/A	O/O	N	F	96"Wx48"Dx12"H	Technical Manufacturing Co.	CleanTop 784-655-02R	with 24" tie-bar leg set 14-426-35
EQ-259	ADA Optics Table	N/A	O/O	N	F	96"Wx48"Dx12"H	Technical Manufacturing Co.	CleanTop 784-655-02R	with 18" tie-bar leg set 14-424-35
EQ-260	Optical Microscope	N/A	O/O	E	B	31"Wx19"Dx19"H	Olympus	SZ60 Stereo Optical Microscope	Not Located
EQ-261	Atomic Force Microscope (AFM)	N/A	O/O	E	B	12"Wx15"Dx36"H	Veeco	Multimode 8	
EQ-262	Atomic Force Microscope (AFM) - SPM Controller & Monitor	N/A	O/O	E	B	24"Wx24"Dx24"H	di - Digital Instruments	Nanoscope V	
EQ-263	Atomic Force Microscope (AFM) - PC & Monitor	N/A	O/O	E	B	36"Wx24"Dx24"H			
EQ-264	Atomic Force Microscope (AFM) - BalanceTable	N/A	O/O	E	F	36"Wx36"Dx30"H	TMC		
EQ-265	FIB (Column)	N/A	O/O	N	F	49"H	FEI Company	Helios Nanolab x50 & 600i	
EQ-266	FIB - Connection Box	N/A	O/O	N	F		FEI Company		
EQ-267	FIB - Mechanical Pump (PVP)	N/A	O/O	N	F	10"Wx17"Dx12"H	FEI Company	BOC-Edwards XDS 10	Located in P16
EQ-268	FIB - Mechanical Console	N/A	O/O	N	F	35"Wx50"Dx30"H	FEI Company		
EQ-269	FIB - Control Desk	N/A	O/O	N	F	55"Wx32"Dx30"H	FEI Company		

Equip No.	Description	Spec. No.	Furnish / Install	New / Exist	Mounted	Size	Manuf.	Model No.	Remarks
EQ-270	FIB - Electric Console	N/A	O/O	N	F	33"Wx24"Dx88"H	FEI Company		
EQ-271	FIB - OneAC Transformer	N/A	O/O	N	F	28"Wx12"Dx12"H	FEI Company		
EQ-272	FIB - UPS	N/A	O/O	N	F	13"Wx24"Dx21"H	FEI Company	LP8-11U	Located in P16
EQ-273	FIB - Chiller	N/A	O/O	N	F	15"Wx25"Dx28"H	FEI Company	Thermoflex 900	Located in P16
EQ-274	Microtome & table	N/A	O/O	E	F	36"Wx36"Dx48"H	Sorvall Porter-Blum	Ultra-microtome MT-2	
EQ-275	Microtome & table	N/A	O/O	N	F	36"Wx36"Dx48"H	Leica	EM FC7 Cryo Chamber	
EQ-276	Microtome & table	N/A	O/O	N	F	36"Wx36"Dx48"H	Leica	Ultra Cut EM UC7	
EQ-277	Knifemaker	N/A	O/O	N	B	12"Wx24"Dx12"H	Leica	EM KMR3	
EQ-278	FESEM - Field Emission Scanning Electron Microscope	N/A	O/O	E	F	76"Wx39"Dx60"H	Zeiss	SIGMA	
EQ-279	FESEM - Rotary Pump	N/A	O/O	E	F		Zeiss		
EQ-280	FESEM - Static Damping Block	N/A	O/O	E	F		Zeiss		
EQ-281	FESEM - Closed-Circuit Cooling Devise	N/A	O/O	E	F		Zeiss	Part # 345980-9001-000	Located in P16
EQ-282	FESEM - Cooling Devise Water Kit	N/A	O/O	E	WL		Zeiss	Part # 348317-9101-000	Located in P16
EQ-283	FESEM - Air Compressor	N/A	O/O	E	F		Zeiss		Located in P16
EQ-284	FESEM - Control Desk	N/A	O/O	E	F		Zeiss		
EQ-285	FESEM - Support PC & Monitor	N/A	O/O	E	B		Zeiss		
EQ-286	FESEM - Microscope Controller & Monitor	N/A	O/O	E	B		Zeiss		
EQ-287	Microscope	N/A	O/O	N	B				
EQ-288	TEM - Transmitting Electron Microscope	N/A	O/O	N	F	67"Wx48"Dx84"H	FEI Company	Tecnai Osiris	
EQ-289	TEM - TEM Cabinet	N/A	O/O	N	F	30"Wx23"Dx32"H	FEI Company		
EQ-290	TEM - Power Cabinet	N/A	O/O	N	F	47"Wx24"Dx51"H	FEI Company		
EQ-291	TEM - High Tension Generator	N/A	O/O	N	F	34"Wx30"Dx64"H	FEI Company	200kV	
EQ-292	TEM - X-FEG Chamber	N/A	O/O	N	F	18"Wx32"Dx32"H	FEI Company	200kV	
EQ-293	TEM - High Tension Tank	N/A	O/O	N	F		FEI Company		
EQ-294	TEM - Flow Meter Rack	N/A	O/O	N	F	30"Wx23"Dx32"H	FEI Company		
EQ-295	TEM - Pump	N/A	O/O	N	F		FEI Company	Scroll PVP XDS 10	
EQ-296	TEM - Accessories Cabinet	N/A	O/O	N	F	32"Wx28"Dx70"H	FEI Company		
EQ-297	TEM - STEM / Acc Cabinet	N/A	O/O	N	F	32"Wx28"Dx70"H	FEI Company		

Equip No.	Description	Spec. No.	Furnish / Install	New / Exist	Mounted	Size	Manuf.	Model No.	Remarks
EQ-298	TEM - System PC	N/A	O/O	N	F		FEI Company		
EQ-299	TEM - Control Desk	N/A	O/O	N	F	51"Wx34"Dx30"H	FEI Company		
EQ-300	TEM - Support PC w/ 2 monitors	N/A	O/O	N	F		FEI Company		
EQ-301	TEM - Closed-Loop Cooling Unit	N/A	O/O	E	F		FEI Company	Lorentz Lens ZEM 300SW	Located in P16
EQ-302	TEM - Cooling Unit Water Filter Kit	N/A	O/O	E	WL		FEI Company	4022 268 02003	Located in P16
EQ-303	TEM - Safety Transformer	N/A	O/O	E	B	15"Wx11"Dx15"H	FEI Company		Located in P16
EQ-304	TEM - Air Compressor	N/A	O/O	E	B		FEI Company		Located in P16
EQ-305	TEM - Power Supply Unit	N/A	O/O	E	F	48"Wx24"Dx51"H	FEI Company		Located in P16
EQ-306	Microscope	N/A	O/O	E	B				
EQ-307	Metallurgical Optical Microscope Workstation	N/A	O/O	E	B		Olympus	GX71	Not Located
EQ-308	Polishing Wheels	N/A	O/O	E	B				
EQ-309	Diamond Cutting Saw	N/A	O/O	E	B	15"Wx15"Dx15"H	South Bay Technology	Model 650	Not Located
EQ-310	Tools	N/A	O/O	N	B				Not Located
EQ-311	Optical Light Microscope	N/A	O/O	E	B	15"Wx8"Dx16"H	Boreal	30525	
EQ-312	Optical Microscope	N/A	O/O	E	B	34"Wx8"Dx21"H	Leica	S8AP0 Stereo Microscope & stand	
EQ-313	Multiprep Polishing System	N/A	O/O	N	B	15"Wx26"Dx20"H	Allied High Tech Products, Inc.	Multiprep #15-2000	
EQ-314	Polishing Station	N/A	O/O	E	B	15"Wx15"Dx10"H	South Bay Technology	Model 900	Inside Fume Hood
EQ-315	Polishing Station	N/A	O/O	E	B	15"Wx15"Dx10"H	South Bay Technology	Model 900	
EQ-316	Polishing Station	N/A	O/O	E	B	26"Wx15"Dx13"H	Allied Tec Prep	M Prep 4	
EQ-317	Multiprep system w/fluid dispenser	N/A	O/O	E	B				
EQ-318	Multiprep 43 Polishing Wheel	N/A	O/O	N	B		Allied		
EQ-319	Ultrasonic Cleaner	N/A	O/O	E	B	13"Wx11"Dx11"H	Fisher Scientific	FS110	
EQ-320	Carbon Sputter Coater	N/A	O/O	E	B	14"Wx19"Dx17"H	SPI Supplies	11423	Need space for Vacuum Pump

Equip No.	Description	Spec. No.	Furnish / Install	New / Exist	Mounted	Size	Manuf.	Model No.	Remarks
EQ-321	Gentle Mill Ion Mill	N/A	O/O	E	B	26"Wx26"Dx24"H	Technoorg - Linda	South Bay Technology Model TL-GM1	
EQ-322	Vented Box	N/A	O/O	E	B				
EQ-323	Multiprep Polishing System	N/A	O/O	N	B	15"Wx26"Dx20"H	Allied High Tech Products, Inc.	Multiprep #15-2000	Located in Vented Box
EQ-324	Fluid Dispensing System	N/A	O/O	E	B	8"Wx25"Dx9"H	Allied High Tech Products, Inc.	Fluid Dispensing AD-5, Item # 5-7000	Located in Vented Box
EQ-325	Multiprep Polishing System	N/A	O/O	E	B	15"Wx26"Dx20"H	Allied High Tech Products, Inc.	Multiprep #15-2000	Located in Fume Hood
EQ-326	Critical Point Dryer	N/A	O/O	E	B	14"Wx22"Dx11"H	Tousimis	Autosamdri-815	
EQ-327	Optical Microscope	N/A	O/O	E	B	21"Wx15"Dx22"H	Olympus	High resolution microscope BH-2	
EQ-328	Elipsometer	N/A	O/O	E	F	36"Wx36"Dx36"H	Rudolph Research	AutoEL	With Table
EQ-329	Dobsonian Telescope	N/A	O/O	E	F		Obsession Telescopes	25" Telescopes	
EQ-330	Computer Station	N/A	O/O	E	F				
EQ-331	Printer	N/A	O/O	N	B				
EQ-332	Water Still	N/A	O/O	E	WL	29"Wx15"Dx54"H	Thermo Scientific	Mega-Pure G A	Not Located. Will stay in Jennings
EQ-333	Acid Bath	N/A	O/O	N	B		Thermo Scientific		Inside Fume Hood
EQ-334	Mercury Analyzer, Controller, & Screen	N/A	O/O	E	B		Milestone	DMA-80	
EQ-335	Freeze Dryer & Pump	N/A	O/O	E	F		Labconco	FreeZone 4.5	On Cart
EQ-336	Vertical Clean Bench	N/A	O/O	E	B	24"Wx30"Dx42"H	Labconco	Purifier - Cat # 3970200	
EQ-337	Vertical Clean Bench	N/A	O/O	E	B	36"Wx30"Dx42"H	Labconco	Purifier	
EQ-338	Centrifuge	N/A	O/O	N	B				
EQ-339	Muffle Furnace	N/A	O/O	N	B				
EQ-340	Particle Size Distribution Analyzer	N/A	O/O	N	B		Horiba	Partica LA-950V2	
EQ-341	Freeze Dryer & Pump	N/A	O/O	N	F		Labconco	FreeZone 4.5	On Cart

Equip No.	Description	Spec. No.	Furnish / Install	New / Exist	Mounted	Size	Manuf.	Model No.	Remarks
EQ-342	***(NOT USED)***								
EQ-343	Desiccator	N/A	O/O	N	B				
EQ-344	Chest Freezer	N/A	O/O	N	F	60"Wx29"Dx41"H			**On Standby power**
EQ-345	Muffle Furnace	N/A	O/O	N	B				
EQ-346	***(NOT USED)***								
EQ-347	Ro-Tap Sieve Shaker	N/A	O/O	N	F				Bolted to Floor
EQ-348	***(NOT USED)***								
EQ-349	***(NOT USED)***								
EQ-350	Touch Tank	N/A	O/O	N	F	6' Dia.			
EQ-351	Phytoplankton Grow Tank	N/A	O/O	N	F	18"Dia x 80"H	Conical Bottom Tanks	CBT68	Free Standing
EQ-352	Laundry Washer	N/A	O/O	N	F				
EQ-353	Laundry Dryer	N/A	O/O	N	F				
EQ-354	Computer Station	N/A	O/O	N	F				
EQ-355	Printer	N/A	O/O	N	B				36" wide roll-fed inkjet
EQ-356	Printer	N/A	O/O	N	B				Color Laser (11 x 17)
EQ-357	Superspeed Refrigerated Centrifuge	N/A	O/O	N	F	28"Wx42"Dx51"H	Thermo Scientific	Sorvall Evolution RC - 728211	
EQ-358	Micro Ultracentrifuge	N/A	O/O	N	B	24"Wx30"Dx16"H	Thermo Scientific	Sorvall MTX 150 - 46961	
EQ-359	Micro Ultracentrifuge	N/A	O/O	N	F	18"Wx20"Dx34"H	Thermo Scientific	Sorvall MX Series - 46951	
EQ-360	***(NOT USED)***								
EQ-361	Centrifuge	N/A	O/O	N	F				
EQ-362	Small N2 Dewar	N/A	O/O	E	F				
EQ-363	Solvent Drum	N/A	O/O	E	F	5 Gallons			
EQ-364	File Cabinet	N/A	O/O	N	F				
EQ-365	Liquid Argon Dewar	N/A	O/O	E	F				
EQ-366	FIB - Air Compressor	N/A	O/O	N	F		FEI Company		Located in P16
EQ-367	FIB - Loader (Crane)	N/A	O/O	N	F	12"Wx14"Dx61"H	FEI Company		Not Required
EQ-368	Circulation Bath for Rotovap	N/A	O/O	E	B	25"Wx8"Dx17"H	Fisher Isotemp	4100 R20	
EQ-369	Circulation Bath for Rotovap	N/A	O/O	N	B	25"Wx8"Dx17"H	Fisher Isotemp	4100 R20	

Equip No.	Description	Spec. No.	Furnish / Install	New / Exist	Mounted	Size	Manuf.	Model No.	Remarks
EQ-370	Table for Magnetic Balance	N/A	O/O	E	F	24"Wx24"Dx24"H			
EQ-371	Refrigerator (Undercounter)	N/A	O/O	N	F				**On Standby power**
EQ-372	Microscope	N/A	O/O	N	B				
EQ-373	Cylinder Supports	123553	C/C	N	WL				
EQ-374	Rotovap - Chiller	N/A	O/O	E	IC				
EQ-375	Explosion Proof Refrigerator	N/A	O/O	N	F				
EQ-376	Future DI Water Polisher	N/A	O/O	N	WL	13"Wx15"Dx20"H	Millipore	Milli-Q Advantage	with Q-POD
EQ-377	DI Water Polishing System	N/A	O/O	E	B				
EQ-378	***(NOT USED)***								
EQ-379	Thermocycler	N/A	O/O	N	B				
EQ-380	Incubating Shaker	N/A	O/O	N	B		Thermo Scientific	14-728-2	
EQ-381	L-Series Incubator Shaker Univ. Platform	N/A	O/O	N	B		Thermo Scientific	14-278-42	
EQ-382	Accessory Flask Clamps - 2 liter	N/A	O/O	N	B		Thermo Scientific	14-281-27	
EQ-383	Accessory Flask Clamps - 1 liter	N/A	O/O	N	B		Thermo Scientific	14-281-26	
EQ-384	Accessory Flask Clamps - 125 ml	N/A	O/O	N	B		Thermo Scientific	14-278-161	
EQ-385	Elutriating Centrifuge	N/A	O/O	N	F	34"Wx28"Dx35"H	Beckman-Coulter	JE6/J26XPI with Avanti J-26XPI	with stobe light assembly & door assembly & viewport
EQ-386	Image Station	N/A	O/O	N	B	25"Wx20"Dx14"H	Carestream Health Inc.	4000 PRO, Cat. # 1046036	with MAC computer
EQ-387	Toxic Gas Cylinder Storage Cabinet	123554	C/C	N	F	18"Wx19"Dx79"H	Matheson Trigas	1177F	Connected to Laser - Located in P16
EQ-388	SEM - Passive Vibration Isolation Platform	N/A	O/O	N	F		TMC	Cradle	

Equip No.	Description	Spec. No.	Furnish / Install	New / Exist	Mounted	Size	Manuf.	Model No.	Remarks
EQ-389	TEM - Passive Vibration Isolation Platform	N/A	O/O	N	F		TMC	Cradle	
EQ-390	FIB - Passive Vibration Isolation Platform	N/A	O/O	N	F		TMC	Cradle	
EQ-391	TEM - Active Vibration Isolation System	N/A	O/O	N	F		STACIS Cradle		To replace the Passive System if required
EQ-392	FIB - Active Vibration Isolation System	N/A	O/O	N	F		STACIS Cradle		To replace the Passive System if required
EQ-393	Drum Rotor	N/A	O/O	N	B	80 x 1.5/2 ml	Thermo Scientific	75007595	
EQ-394	PCR strips with 8 tubes rack / Nature	N/A	O/O	N	B		Thermo Scientific	76001587	
EQ-395	Microliter tubes rack / Red	N/A	O/O	N	B	1.5/2 ml	Thermo Scientific	76001244	
EQ-396	Fixed-Angle Highconic Rotor with Cover	N/A	O/O	N	B	6 x 50 ml	Thermo Scientific	75007588	
EQ-397	Disposable Conocal Adaptor for EQ-396	N/A	O/O	N	B	15 ml	Thermo Scientific	75003095	
EQ-398	Swinging Bucket Rotor	N/A	O/O	N	B	4 x 100 ml	Thermo Scientific	75007591	
EQ-399	Disposable Conocal Adaptor for EQ-398	N/A	O/O	N	B	50 ml	Thermo Scientific	75007557	
EQ-400	Disposable Conocal Adaptor for EQ-398	N/A	O/O	N	B	15 ml	Thermo Scientific	75007556	
EQ-401	Round Buckets	N/A	O/O	N	B		Thermo Scientific	75007555	
EQ-402	Aerosol-Tight Cap	N/A	O/O	N	B		Thermo Scientific	75007598	
EQ-403	Large Laser Table	N/A	O/O	E	F	144"Wx59"Dx12"H			
EQ-404	Small Laser Table	N/A	O/O	E	F	72"Wx59"Dx12"H			
EQ-405	Rotovap Chiller	N/A	O/O	N	B	10"Wx20"Dx24"H	ThermoFisher	Neslab RTE7	Inside Fume Hood.
EQ-406	Balance	N/A	O/O	N	B	15"Wx10"Dx14"H	Denver Instruments	P-314	

Equip No.	Description	Spec. No.	Furnish / Install	New / Exist	Mounted	Size	Manuf.	Model No.	Remarks

N/A	Not Applicable
N	New Equipment
E	Existing Equipment
B	Bench Top Equipment
F	Floor Mounted Equipment
WL	Wall Mounted Equipment
S	Suspended Equipment
C	Ceiling Mounted Equipment
IC	Inside Cabinet Equipment
L	Length
W	Width
H	Height
O/O	Owner Furnished / Owner Installed
C/C	Contractor Furnished / Contractor Installed
BSC	Biosafety Cabinet
ADA	Americans with Disabilities Act

Room Number	Program No.	Space Name	Equip No.	Description	Quantity	Spec. No.	Furnish / Install	New / Exist	Mounted	Size	Manuf.	Model No.	Remarks
013	P08	Nanotechnology Teaching Lab	FH-01	Fume Hood - 6'	1	115313	C/C	N	F	72"Wx36"Dx84"H	Kewaunee	H05_5472B00	Restricted-By-Pass
013	P08	Nanotechnology Teaching Lab	FH-02	ADA Fume Hood - 6'	1	115313	C/C	N	F	72"Wx36"Dx84"H	Kewaunee	H08_5472B00	Restricted-By-Pass
015	P08-1	Nanotechnology Project Storage / Prep Lab	EQ-004	DI Water Polisher	1	115360	C/C	N	IC	13"Wx15"Dx20"H	Millipore	Milli-Q Advantage	with Q-POD
015	P08-1	Nanotechnology Project Storage / Prep Lab	FH-04	ADA Fume Hood - 4'	1	115313	C/C	N	F	48"Wx36"Dx84"H	Kewaunee	H05_5448B00	Restricted-By-Pass
017		Storage Closet											
019	P14	NTC Multi Purpose Support / Prep	EQ-004	DI Water Polisher	1	115360	C/C	N	IC	13"Wx15"Dx20"H	Millipore	Milli-Q Advantage	with Q-POD
019	P14	NTC Multi Purpose Support / Prep	EQ-066	Analytical Balance	1	N/A	O/O	E	B	12"Wx18"Dx12"H	Mettler Toledo	AB54-S/FACT	
019	P14	NTC Multi Purpose Support / Prep	EQ-074	Oven	1	N/A	O/O	E	B	24"Wx24"Dx24"H	Blue M	SW - 17TA-1	Not Located
019	P14	NTC Multi Purpose Support / Prep	EQ-307	Metallurgical Optical Microscope Workstation	1	N/A	O/O	E	B		Olympus	GX71	Not Located
019	P14	NTC Multi Purpose Support / Prep	EQ-308	Polishing Wheels		N/A	O/O	E	B				
019	P14	NTC Multi Purpose Support / Prep	EQ-309	Diamond Cutting Saw	1	N/A	O/O	E	B	15"Wx15"Dx15"H	South Bay Technology	Model 650	Not Located
019	P14	NTC Multi Purpose Support / Prep	EQ-310	Tools		N/A	O/O	N	B				Not Located
019	P14	NTC Multi Purpose Support / Prep	EQ-311	Optical Light Microscope	1	N/A	O/O	E	B	15"Wx8"Dx16"H	Boreal	30525	
019	P14	NTC Multi Purpose Support / Prep	EQ-312	Optical Microscope	1	N/A	O/O	E	B	34"Wx8"Dx21"H	Leica	S8AP0 Stereo Microscope & stand	
019	P14	NTC Multi Purpose Support / Prep	EQ-313	Multiprep Polishing System	1	N/A	O/O	N	B	15"Wx26"Dx20"H	Allied High Tech Products, Inc.	Multiprep #15-2000	
019	P14	NTC Multi Purpose Support / Prep	EQ-314	Polishing Station	1	N/A	O/O	E	B	15"Wx15"Dx10"H	South Bay Technology	Model 900	Inside Fume Hood
019	P14	NTC Multi Purpose Support / Prep	EQ-315	Polishing Station	1	N/A	O/O	E	B	15"Wx15"Dx10"H	South Bay Technology	Model 900	
019	P14	NTC Multi Purpose Support / Prep	EQ-316	Polishing Station	1	N/A	O/O	E	B	26"Wx15"Dx13"H	Allied Tec Prep	M Prep 4	
019	P14	NTC Multi Purpose Support / Prep	EQ-317	Multiprep system w/fluid dispenser	1	N/A	O/O	E	B				
019	P14	NTC Multi Purpose Support / Prep	EQ-318	Multiprep 43 Polishing Wheel	1	N/A	O/O	N	B		Allied		
019	P14	NTC Multi Purpose Support / Prep	EQ-319	Ultrasonic Cleaner	1	N/A	O/O	E	B	13"Wx11"Dx11"H	Fisher Scientific	FS110	
019	P14	NTC Multi Purpose Support / Prep	FH-01	Fume Hood - 6'	2	115313	C/C	N	F	72"Wx36"Dx84"H	Kewaunee	H05_5472B00	Restricted-By-Pass
019	P14	NTC Multi Purpose Support / Prep	FH-02	ADA Fume Hood - 6'	1	115313	C/C	N	F	72"Wx36"Dx84"H	Kewaunee	H08_5472B00	Restricted-By-Pass
027	P15	NTC Specimen Prep Specialized Process	EQ-004	DI Water Polisher	1	115360	C/C	N	IC	13"Wx15"Dx20"H	Millipore	Milli-Q Advantage	with Q-POD
027	P15	NTC Specimen Prep Specialized Process	EQ-012	Exhaust Canopy	1	Div 23	C/C	N	C				Above Sputter Coater
027	P15	NTC Specimen Prep Specialized Process	EQ-080	Vacuum Pump	2	N/A	O/O	E	IC		Alcatel	4101030421	Inside cabinet under hood
027	P15	NTC Specimen Prep Specialized Process	EQ-320	Carbon Sputter Coater	1	N/A	O/O	E	B	14"Wx19"Dx17"H	SPI Supplies	11423	Need space for Vacuum Pump
027	P15	NTC Specimen Prep Specialized Process	EQ-321	Gentle Mill Ion Mill	1	N/A	O/O	E	B	26"Wx26"Dx24"H	Technoorg - Linda	South Bay Technology Model TL-GM1	
027	P15	NTC Specimen Prep Specialized Process	EQ-322	Vented Box	1	N/A	O/O	E	B				

Room Number	Program No.	Space Name	Equip No.	Description	Quantity	Spec. No.	Furnish / Install	New / Exist	Mounted	Size	Manuf.	Model No.	Remarks
027	P15	NTC Specimen Prep Specialized Process	EQ-323	Multiprep Polishing System	1	N/A	O/O	N	B	15"Wx26"Dx20"H	Allied High Tech Products, Inc.	Multiprep #15-2000	Located in Vented Box
027	P15	NTC Specimen Prep Specialized Process	EQ-324	Fluid Dispensing System	1	N/A	O/O	E	B	8"Wx25"Dx9"H	Allied High Tech Products, Inc.	Fluid Dispensing AD-5, Item # 5-7000	Located in Vented Box
027	P15	NTC Specimen Prep Specialized Process	EQ-325	Multiprep Polishing System	1	N/A	O/O	E	B	15"Wx26"Dx20"H	Allied High Tech Products, Inc.	Multiprep #15-2000	Located in Fume Hood
027	P15	NTC Specimen Prep Specialized Process	EQ-326	Critical Point Dryer	1	N/A	O/O	E	B	14"Wx22"Dx11"H	Tousimis	Autosamdri-815	
027	P15	NTC Specimen Prep Specialized Process	EQ-371	Refrigerator (Undercounter)	1	N/A	O/O	N	F				**On Standby power**
027	P15	NTC Specimen Prep Specialized Process	FH-03	Fume Hood - 4'	1	115313	C/C	N	F	48"Wx36"Dx84"H	Kewaunee	H05_5448B00	Restricted-By-Pass
027	P15	NTC Specimen Prep Specialized Process	FH-04	ADA Fume Hood - 4'	1	115313	C/C	N	F	48"Wx36"Dx84"H	Kewaunee	H08_5448B00	Restricted-By-Pass
029	P11	NTC Microtomy Lab	EQ-272	Microscope	1	N/A	O/O	N	B				
029	P11	NTC Microtomy Lab	EQ-274	Microtome & table	1	N/A	O/O	E	F	36"Wx36"Dx48"H	Sorvall Porter-Blum	Ultra-microtome MT-2	
029	P11	NTC Microtomy Lab	EQ-275	Microtome & table	1	N/A	O/O	N	F	36"Wx36"Dx48"H	Leica	EM FC7 Cryo Chamber	
029	P11	NTC Microtomy Lab	EQ-276	Microtome & table	1	N/A	O/O	N	F	36"Wx36"Dx48"H	Leica	Ultra Cut EM UC7	
029	P11	NTC Microtomy Lab	EQ-277	Knifemaker	1	N/A	O/O	N	B	12"Wx24"Dx12"H	Leica	EM KMR3	
031	P03	Materials Science R.T. Lab	EQ-004	DI Water Polisher	1	115360	C/C	N	IC	13"Wx15"Dx20"H	Millipore	Milli-Q Advantage	with Q-POD
031	P03	Materials Science R.T. Lab	EQ-229	Optical Microscope	1	N/A	O/O	E	B	21"Wx15"Dx22"H	Olympus	High resolution microscope BH-2	
031	P03	Materials Science R.T. Lab	EQ-230	Optical Microscope	1	N/A	O/O	E	B	14"Wx8"Dx16"H	Zeiss	Optical	
031	P03	Materials Science R.T. Lab	EQ-231	Electron Microscope (SEM)	1	N/A	O/O	E	B	26"Wx36"Dx48"H	Hitachi	TM-1000 (Portable)	Microscope & Monitor On Cart
031	P03	Materials Science R.T. Lab	EQ-232	Electron Microscope - X-Ray Controller	1	N/A	O/O	E	B				On Cart
031	P03	Materials Science R.T. Lab	EQ-234	Electron Microscope - Pump	1	N/A	O/O	E	F				
031	P03	Materials Science R.T. Lab	EQ-235	UV-VIS Spectrophotometer	1	N/A	O/O	E	B	40"Wx26"Dx11"H	Shimadzu	UV-3600	With PC & Printer
031	P03	Materials Science R.T. Lab	EQ-236	Elipsometer	1	N/A	O/O	E	F	36"Wx36"Dx36"H	Research	AutoEL	With Table
031	P03	Materials Science R.T. Lab	EQ-237	X-ray Fluorescence Spectroscopy	1	N/A	O/O	E	B	23"Wx27"Dx30"H	Analytical	MIDEX	
031	P03	Materials Science R.T. Lab	EQ-238	Indentation Tester	1	N/A	O/O	N	F	36"Wx36"Dx36"H	Instruments	Nano	
031	P03	Materials Science R.T. Lab	EQ-239	Tensile Strength Tester	1	N/A	O/O	N	B	18"Wx24"Dx55"H	Instron	5940 Series Single Column Low Force	(8 Tons)
031	P03	Materials Science R.T. Lab	FH-02	ADA Fume Hood - 6'	1	115313	C/C	N	F	72"Wx36"Dx84"H	Kewaunee	H08_5472B00	Restricted-By-Pass
032	P12	NTC SEM Lab	EQ-278	FESEM - Field Emission Scanning Electron Microscope	1	N/A	O/O	E	F	76"Wx39"Dx60"H	Zeiss	SIGMA	
032	P12	NTC SEM Lab	EQ-279	FESEM - Rotary Pump	1	N/A	O/O	E	F		Zeiss		
032	P12	NTC SEM Lab	EQ-280	FESEM - Static Damping Block	1	N/A	O/O	E	F		Zeiss		
032	P12	NTC SEM Lab	EQ-281	FESEM - Closed-Circuit Cooling Devise	1	N/A	O/O	E	F		Zeiss	Part # 345980-9001-000	Located in P16

Room Number	Program No.	Space Name	Equip No.	Description	Quantity	Spec. No.	Furnish / Install	New / Exist	Mounted	Size	Manuf.	Model No.	Remarks
032	P12	NTC SEM Lab	EQ-282	FESEM - Cooling Devise Water Kit	1	N/A	O/O	E	WL		Zeiss	Part # 348317-9101-000	Located in P16
032	P12	NTC SEM Lab	EQ-283	FESEM - Air Compressor	1	N/A	O/O	E	F		Zeiss		Located in P16
032	P12	NTC SEM Lab	EQ-284	FESEM - Control Desk	1	N/A	O/O	E	F		Zeiss		
032	P12	NTC SEM Lab	EQ-285	FESEM - Support PC & Monitor	1	N/A	O/O	E	B		Zeiss		
032	P12	NTC SEM Lab	EQ-286	FESEM - Microscope Controller & Monitor	1	N/A	O/O	E	B		Zeiss		
032	P12	NTC SEM Lab	EQ-287	Microscope	1	N/A	O/O	N	B				
032	P12	NTC SEM Lab	EQ-388	SEM - Passive Vibration Isolation Platform	1	N/A	O/O	N	F		TMC	Cradle	
033	P17	Prep Lab	EQ-004	DI Water Polisher	1	115360	C/C	N	IC	13"Wx15"Dx20"H	Millipore	Milli-Q Advantage	with Q-POD
033	P17	Prep Lab	EQ-327	Optical Microscope	1	N/A	O/O	E	B	21"Wx15"Dx22"H	Olympus	High resolution microscope BH-2	
033	P17	Prep Lab	EQ-328	Elipsometer	1	N/A	O/O	E	F	36"Wx36"Dx36"H	Rudolph Research	AutoEL	With Table
033	P17	Prep Lab	FH-07	ADA Perchloric Fume Hood - 4'	1	115313	C/C	N	F	48"Wx36"Dx84"H	Kewaunee	H25L5448-00	Open-By-Pass
034	P13	NTC TEM Lab	EQ-288	TEM - Transmitting Electron Microscope	1	N/A	O/O	N	F	67"Wx48"Dx84"H	FEI Company	Tecnai Osiris	
034	P13	NTC TEM Lab	EQ-289	TEM - TEM Cabinet	1	N/A	O/O	N	F	30"Wx23"Dx32"H	FEI Company		
034	P13	NTC TEM Lab	EQ-290	TEM - Power Cabinet	1	N/A	O/O	N	F	47"Wx24"Dx51"H	FEI Company		
034	P13	NTC TEM Lab	EQ-291	TEM - High Tension Generator	1	N/A	O/O	N	F	34"Wx30"Dx64"H	FEI Company	200kV	
034	P13	NTC TEM Lab	EQ-292	TEM - X-FEG Chamber	1	N/A	O/O	N	F	18"Wx32"Dx32"H	FEI Company	200kV	
034	P13	NTC TEM Lab	EQ-293	TEM - High Tension Tank	1	N/A	O/O	N	F		FEI Company		
034	P13	NTC TEM Lab	EQ-294	TEM - Flow Meter Rack	1	N/A	O/O	N	F	30"Wx23"Dx32"H	FEI Company		
034	P13	NTC TEM Lab	EQ-295	TEM - Pump	1	N/A	O/O	N	F		FEI Company	Scroll PVP XDS 10	
034	P13	NTC TEM Lab	EQ-296	TEM - Accessories Cabinet	1	N/A	O/O	N	F	32"Wx28"Dx70"H	FEI Company		
034	P13	NTC TEM Lab	EQ-297	TEM - STEM / Acc Cabinet	1	N/A	O/O	N	F	32"Wx28"Dx70"H	FEI Company		
034	P13	NTC TEM Lab	EQ-298	TEM - System PC	1	N/A	O/O	N	F		FEI Company		
034	P13	NTC TEM Lab	EQ-299	TEM - Control Desk	1	N/A	O/O	N	F	51"Wx34"Dx30"H	FEI Company		
034	P13	NTC TEM Lab	EQ-300	TEM - Support PC w/ 2 monitors	1	N/A	O/O	N	F		FEI Company		
034	P13	NTC TEM Lab	EQ-301	TEM - Closed-Loop Cooling Unit	1	N/A	O/O	E	F		FEI Company	Lorentz Lens ZEM 300SW	Located in P16
034	P13	NTC TEM Lab	EQ-302	TEM - Cooling Unit Water Filter Kit	1	N/A	O/O	E	WL		FEI Company	4022 268 02003	Located in P16
034	P13	NTC TEM Lab	EQ-303	TEM - Safety Transformer	1	N/A	O/O	E	B	15"Wx11"Dx15"H	FEI Company		Located in P16
034	P13	NTC TEM Lab	EQ-304	TEM - Air Compressor	1	N/A	O/O	E	B		FEI Company		Located in P16
034	P13	NTC TEM Lab	EQ-305	TEM - Power Supply Unit	1	N/A	O/O	E	F	48"Wx24"Dx51"H	FEI Company		Located in P16
034	P13	NTC TEM Lab	EQ-306	Microscope	1	N/A	O/O	E	B				
034	P13	NTC TEM Lab	EQ-389	TEM - Passive Vibration Isolation Platform	1	N/A	O/O	N	F		TMC	Cradle	
034	P13	NTC TEM Lab	EQ-391	TEM - Active Vibration Isolation System	1	N/A	O/O	N	F		STACIS Cradle		To replace the Passive System if required
035		Tank Storage	EQ-373	Cylinder Supports	1	123553	C/C	N	WL				
036	P16	NTC Utility Room	EQ-049	Glove Box Purifier	1	N/A	O/O	E	F		M. Braun		Linked to Glove Box in P04
036	P16	NTC Utility Room	EQ-081	Vacuum Pump	2	N/A	O/O	E	F				

Room Number	Program No.	Space Name	Equip No.	Description	Quantity	Spec. No.	Furnish / Install	New / Exist	Mounted	Size	Manuf.	Model No.	Remarks
036	P16	NTC Utility Room	EQ-145	Liquid N2 Dewar	2	N/A	O/O	N	F				
036	P16	NTC Utility Room	EQ-244	Turbomolecular Pump - Mechanical Pump	1	N/A	O/O	E	F				Linked to Turbo Pump in P04
036	P16	NTC Utility Room	EQ-387	Toxic Gas Cylinder Storage Cabinet	2	123554	C/C	N	F	18"Wx19"Dx79"H	Matheson Trigas	1177F	Linked to Laser in P04
036	P16	NTC Utility Room	EQ-267	FIB - Mechanical Pump (PVP)	1	N/A	O/O	N	F	10"Wx17"Dx12"H	FEI Company	BOC-Edwards XDS 10	Linked to FIB in P10
036	P16	NTC Utility Room	EQ-272	FIB - UPS	1	N/A	O/O	N	F	13"Wx24"Dx21"H	FEI Company	LP8-11U	Linked to FIB in P10
036	P16	NTC Utility Room	EQ-273	FIB - Chiller	1	N/A	O/O	N	F	15"Wx25"Dx28"H	FEI Company	Thermoflex 900	Linked to FIB in P10
036	P16	NTC Utility Room	EQ-281	FESEM - Closed-Circuit Cooling Devise	1	N/A	O/O	E	F		Zeiss	Part # 345980-9001-000	Linked to SEM in P12
036	P16	NTC Utility Room	EQ-282	FESEM - Cooling Devise Water Kit	1	N/A	O/O	E	WL		Zeiss	Part # 348317-9101-000	Linked to SEM in P12
036	P16	NTC Utility Room	EQ-283	FESEM - Air Compressor	1	N/A	O/O	E	F		Zeiss		Linked to SEM in P12
036	P16	NTC Utility Room	EQ-301	TEM - Closed-Loop Cooling Unit	1	N/A	O/O	E	F		FEI Company	Lorentz Lens ZEM 300SW	Linked to TEM in P13
036	P16	NTC Utility Room	EQ-302	TEM - Cooling Unit Water Filter Kit	1	N/A	O/O	E	WL		FEI Company	4022 268 02003	Linked to TEM in P13
036	P16	NTC Utility Room	EQ-303	TEM - Safety Transformer	1	N/A	O/O	E	B	15"Wx11"Dx15"H	FEI Company		Linked to TEM in P13
036	P16	NTC Utility Room	EQ-304	TEM - Air Compressor	1	N/A	O/O	E	B		FEI Company		Linked to TEM in P13
036	P16	NTC Utility Room	EQ-305	TEM - Power Supply Unit	1	N/A	O/O	E	F	48"Wx24"Dx51"H	FEI Company		Linked to TEM in P13
036	P16	NTC Utility Room	EQ-366	FIB - Air Compressor	1	N/A	O/O	N	F		FEI Company		Linked to FIB in P10
037	P01	High Resolution Optics R.T. Lab	EQ-019	BioSafety Cabinet - Type II A2 - 6'	1	N/A	O/O	N	F	78"Wx33"Dx95"H	NuAire	NU-425-600	Non-Ducted
037	P01	High Resolution Optics R.T. Lab	EQ-206	N-Storm Microscope	1	N/A	O/O	N	B		Nikon	N-Storm Super-Resolution	**On Standby power**
037	P01	High Resolution Optics R.T. Lab	EQ-258	Optics Table	1	N/A	O/O	N	F	96"Wx48"Dx12"H	Technical Manufacturing Co.	CleanTop 784-655-02R	with 24" tie-bar leg set 14-426-35
037	P01	High Resolution Optics R.T. Lab	EQ-371	Refrigerator (Undercounter)	1	N/A	O/O	N	F				**On Standby power**
037	P01	High Resolution Optics R.T. Lab	FH-04	ADA Fume Hood - 4'	1	115313	C/C	N	F	48"Wx36"Dx84"H	Kewaunee	H05_5448B00	Restricted-By-Pass
038	P10	NTC AFM / FIB Instrument Lab	EQ-261	Atomic Force Microscope (AFM)	1	N/A	O/O	E	B	12"Wx15"Dx36"H	Veeco	Multimode 8	
038	P10	NTC AFM / FIB Instrument Lab	EQ-262	Atomic Force Microscope (AFM) - SPM Controller & Monitor	1	N/A	O/O	E	B	24"Wx24"Dx24"H	di - Digital Instruments	Nanoscope V	
038	P10	NTC AFM / FIB Instrument Lab	EQ-263	Atomic Force Microscope (AFM) - PC & Monitor	1	N/A	O/O	E	B	36"Wx24"Dx24"H			
038	P10	NTC AFM / FIB Instrument Lab	EQ-264	Atomic Force Microscope (AFM) - BalanceTable	1	N/A	O/O	E	F	47"Wx36"Dx32"H	Technical Manufacturing Co.	20-563	
038	P10	NTC AFM / FIB Instrument Lab	EQ-265	FIB	1	N/A	O/O	N	F	49"H	FEI Company	Helios Nanolab x50 & 600i	
038	P10	NTC AFM / FIB Instrument Lab	EQ-266	FIB - Connection Box	1	N/A	O/O	N	F		FEI Company		
038	P10	NTC AFM / FIB Instrument Lab	EQ-267	FIB - Mechanical Pump	1	N/A	O/O	N	F	10"Wx17"Dx12"H	FEI Company	BOC-Edwards XDS 10	Located in P16
038	P10	NTC AFM / FIB Instrument Lab	EQ-268	FIB - Mechanical Console	1	N/A	O/O	N	F	35"Wx50"Dx30"H	FEI Company		
038	P10	NTC AFM / FIB Instrument Lab	EQ-269	FIB - Control Desk	1	N/A	O/O	N	F	55"Wx32"Dx30"H	FEI Company		

Room Number	Program No.	Space Name	Equip No.	Description	Quantity	Spec. No.	Furnish / Install	New / Exist	Mounted	Size	Manuf.	Model No.	Remarks
038	P10	NTC AFM / FIB Instrument Lab	EQ-270	FIB - Electric Console	1	N/A	O/O	N	F	33"Wx24"Dx88"H	FEI Company		
038	P10	NTC AFM / FIB Instrument Lab	EQ-271	FIB - OneAC Transformer	1	N/A	O/O	N	F	28"Wx12"Dx12"H	FEI Company		
038	P10	NTC AFM / FIB Instrument Lab	EQ-272	FIB - UPS	1	N/A	O/O	N	F	13"Wx24"Dx21"H	FEI Company	LP8-11U	Located in P16
038	P10	NTC AFM / FIB Instrument Lab	EQ-273	FIB - Chiller	1	N/A	O/O	N	F	15"Wx25"Dx28"H	FEI Company	Thermoflex 900	Located in P16
038	P10	NTC AFM / FIB Instrument Lab	EQ-366	FIB - Air Compressor	1	N/A	O/O	N	F		FEI Company		Located in P16
038	P10	NTC AFM / FIB Instrument Lab	EQ-367	FIB - Loader (Crane)	1	N/A	O/O	N	F	12"Wx14"Dx61"H	FEI Company		Not Required
038	P10	NTC AFM / FIB Instrument Lab	EQ-390	FIB - Passive Vibration Isolation Platform		N/A	O/O	N	F		TMC	Cradle	
038	P10	NTC AFM / FIB Instrument Lab	EQ-392	FIB - Active Vibration Isolation System		N/A	O/O	N	F		STACIS Cradle		To replace the Passive System if required
042	P04	Nanomaterials R.T. Lab	EQ-004	DI Water Polisher	1	115360	C/C	N	IC	13"Wx15"Dx20"H	Millipore	Milli-Q Advantage	with Q-POD
042	P04	Nanomaterials R.T. Lab	EQ-048	Glove Box	1	N/A	O/O	E	F	83"Wx32"Dx60"H	M. Braun	Unilab	Requires Compressed Air & Cooling water hookup
042	P04	Nanomaterials R.T. Lab	EQ-049	Glove Box Purifier	1	N/A	O/O	E	F		M. Braun		Located in P16
042	P04	Nanomaterials R.T. Lab	EQ-050	Glove Box Vacuum Pump	1	N/A	O/O	E	F		M. Braun		
042	P04	Nanomaterials R.T. Lab	EQ-051	Glove Box Heavy Duty Table (Granite)	1	N/A	O/O	E	F				
042	P04	Nanomaterials R.T. Lab	EQ-240	Atomic Force Microscope (AFM)	1	N/A	O/O	E	B		Veeco	Multimode 8	Inside Glove Box with vibration dampening
042	P04	Nanomaterials R.T. Lab	EQ-242	Turbomolecular Pump	2	N/A	O/O	E	B		Varian	V-250	Connected to Vacuum Chamber
042	P04	Nanomaterials R.T. Lab	EQ-243	Vacuum Chamber	1	N/A	O/O	E	B	24"Wx24"Dx36"H	Kurt J. Lesker	Custom Made	On Optics Table
042	P04	Nanomaterials R.T. Lab	EQ-244	Mechanical Pump	1	N/A	O/O	E	F				Connected to Turbo Pump - Located in P16
042	P04	Nanomaterials R.T. Lab	EQ-245	Optics Table	1	N/A	O/O	N	F	120"Wx59"Dx12"H	Technical Manufacturing Co.	CleanTop 784-673-02R	with 24" tie-bar leg set 14-426-35
042	P04	Nanomaterials R.T. Lab	EQ-246	Eximer Laser	1	N/A	O/O	N	B	31"Wx17"Dx16"H	GAM Laser	EX350	Class IV Laser. On Optics Table. Requires Cooling water hookup
042	P04	Nanomaterials R.T. Lab	EQ-247	Pump for Eximer Laser	1	N/A	O/O	N	F				Requires venting
042	P04	Nanomaterials R.T. Lab	EQ-248	ND YAG Laser	1	N/A	O/O	E	B		Quantel	YG660A	Class IV Laser. On Optics Table. Requires Cooling water hookup
042	P04	Nanomaterials R.T. Lab	EQ-387	Toxic Gas Cylinder Storage Cabinet	2	123554	C/C	N	F	18"Wx19"Dx79"H	Matheson Trigas	1177F	Connected to Laser - Located in P16
103	V03	Coastal & Marine Studies Teaching Lab	EQ-024	(4°C) Refrigerator	1	N/A	O/O	N	F	36"Wx34"Dx70"H			
103	V03	Coastal & Marine Studies Teaching Lab	EQ-030	Freezer	1	N/A	O/O	N	F	32"Wx31"Dx70"H			
103	V03	Coastal & Marine Studies Teaching Lab	FH-01	Fume Hood - 6'	2	115313	C/C	N	F	72"Wx36"Dx84"H	Kewaunee	H05_5472B00	Restricted-By-Pass
103	V03	Coastal & Marine Studies Teaching Lab	FH-02	ADA Fume Hood - 6'	1	115313	C/C	N	F	72"Wx36"Dx84"H	Kewaunee	H08_5472B00	Restricted-By-Pass
103A	V04	Coastal & Marine Studies Prep Lab	EQ-001	Glassware Washer (Flask Scrubber)	1	115319	C/C	N	F	24"Wx24"Dx34"H	Labconco	4420330	Undercounter

Room Number	Program No.	Space Name	Equip No.	Description	Quantity	Spec. No.	Furnish / Install	New / Exist	Mounted	Size	Manuf.	Model No.	Remarks
103A	V04	Coastal & Marine Studies Prep Lab	FH-02	ADA Fume Hood - 6'	1	115313	C/C	N	F	72"Wx36"Dx84"H	Kewaunee	H08_5472B00	Restricted-By-Pass
	S01	Ground Floor Wet Lab / Mud Room	EQ-024	(4°C) Refrigerator	1	N/A	O/O	N	F	36"Wx34"Dx70"H			
109	S01	Ground Floor Wet Lab / Mud Room	EQ-352	Laundry Washer	1	N/A	O/O	N	F				
109	S01	Ground Floor Wet Lab / Mud Room	EQ-353	Laundry Dryer	1	N/A	O/O	N	F				
109A	V05	Field Equipment Storage Room	EQ-347	Ro-Tap Sieve Shaker	1	N/A	O/O	E	F				Bolted to Floor
111	V06	Saltwater Aquarium Room	EQ-350	Touch Tank	1	N/A	O/O	N	F	6' Dia.			
111A	V08	Storage Room											
111B	V07	Phytoplankton Room	EQ-351	Phytoplankton Grow Tank	3	N/A	O/O	N	F	18"Dia x 80"H	Conical Bottom Tanks	CBT68	Free Standing
116	E11	Rock Sample Storage	EQ-015	High Density Shelving System	1	105630	C/C	N	F		SpaceSaver Systems, Inc.		
119	E15	Rock Sample Prep Dirty-Wet Lab	EQ-007	Dust Extractor Arm	3	115360	C/C	N	C	8' L	E-Z Arm	II High Flow Extractor	
119	E15	Rock Sample Prep Dirty-Wet Lab	EQ-014	Dust Ventilation System	1	Div 23	C/C	N	C				Part of building vent system. Vents outside
119	E15	Rock Sample Prep Dirty-Wet Lab	EQ-016	Downdraft Booth	2	115360	C/C	N	F	72"Wx54"Dx80"H	Dual Draw, Air Cleaning Specialists	TB 3072-5000	
119	E15	Rock Sample Prep Dirty-Wet Lab	EQ-184	Slab Saw (30")	1	N/A	O/O	N	F	30" dia. (10'x8')	Kingsley North		Oil Cooled
119	E15	Rock Sample Prep Dirty-Wet Lab	EQ-185	Sand Pit (Box)	1	N/A	O/O	E	F	48"Wx48"D			Built from lumber
119	E15	Rock Sample Prep Dirty-Wet Lab	EQ-186	Large Jaw Crusher	1	N/A	O/O	E	F	48"Wx48"D	Bico	Bico Chipmunk	4" Vent Port (Built-In)
119	E15	Rock Sample Prep Dirty-Wet Lab	EQ-187	Large Ring / Puck Mill	1	N/A	O/O	E	F	36"Wx36"D	Spex Certiprep	Spex 8500 Shatterbox	Shatterbox w/ agate or Al-Ceramic grinding head
119	E15	Rock Sample Prep Dirty-Wet Lab	EQ-188	Hydraulic Rock Splitter	1	N/A	O/O	N	F	48"Wx36"D	Wards Natural Science		
119	E15	Rock Sample Prep Dirty-Wet Lab	EQ-189	Drill Press	1	N/A	O/O	N	F	20"Wx36"Dx70"H			W/ Diamond Core Bits. Requires Hose bib & Drain with sediment trap
119	E15	Rock Sample Prep Dirty-Wet Lab	EQ-190	RO-TAP Sieve Shaker	2	N/A	O/O	E	B	30"Wx24"D	W.S. Tyler	RX-29	
119	E15	Rock Sample Prep Dirty-Wet Lab	EQ-191	Large Disc Mill	1	N/A	O/O	E	F	40"Wx30"Dx20"H	Bico	Bico UA Disk Pulverizer	Inside Downdraft Booth
119	E15	Rock Sample Prep Dirty-Wet Lab	EQ-192	Small Jaw Crusher	1	N/A	O/O	E	B	14"Wx25"D	Sepor		Inside Downdraft Booth
119	E15	Rock Sample Prep Dirty-Wet Lab	EQ-193	Small Disc Mill	1	N/A	O/O	E	B	16"Wx12"D	Sepor		Inside Downdraft Booth
119	E15	Rock Sample Prep Dirty-Wet Lab	EQ-194	Small Ring / Puck Mill	1	N/A	O/O	E	B	18"Wx22"D	Rock Labs		
119	E15	Rock Sample Prep Dirty-Wet Lab	EQ-195	Trim Saw	2	N/A	O/O	E	B	20"Wx30"D			Requires Cooling water hookup & Sink / Drain
119	E15	Rock Sample Prep Dirty-Wet Lab	FH-02	ADA Fume Hood - 6'	1	115313	C/C	N	F	72"Wx36"Dx84"H	Kewaunee	H08_5472B00	Restricted-By-Pass
123	E16	Rock Sample Prep Dirty-Dry Lab	EQ-004	DI Water Polisher	1	115360	C/C	N	IC	13"Wx15"Dx20"H	Millipore	Milli-Q Advantage	with Q-POD
123	E16	Rock Sample Prep Dirty-Dry Lab	EQ-035	Chest Freezer	1	N/A	O/O	N	F	8 foot			
123	E16	Rock Sample Prep Dirty-Dry Lab	EQ-073	Oven	2	N/A	O/O	E	B	24"Wx25"D			
123	E16	Rock Sample Prep Dirty-Dry Lab	EQ-196	Vibratory Lap	2	N/A	O/O	N	B	20"Wx20"D	Kingsley North		
123	E16	Rock Sample Prep Dirty-Dry Lab	EQ-197	Thin Section Machine	1	N/A	O/O	E	B	30"Wx28"D			Requires water hookup & Drain

Room Number	Program No.	Space Name	Equip No.	Description	Quantity	Spec. No.	Furnish / Install	New / Exist	Mounted	Size	Manuf.	Model No.	Remarks
123	E16	Rock Sample Prep Dirty-Dry Lab	EQ-198	Polishing Wheels	2	N/A	O/O	E	B	14"Wx14"D			Requires Drain
123	E16	Rock Sample Prep Dirty-Dry Lab	EQ-199	Grounding & Polishing Counsel	2	N/A	O/O	N	F	60"Wx30"D	Leco (or Buhler)	Metallographic Two-Wheel console	Requires Cooling water hookup
123	E16	Rock Sample Prep Dirty-Dry Lab	EQ-200	Small Muffle Furnace	3	N/A	O/O	E	B	12"Wx12"D			
123	E16	Rock Sample Prep Dirty-Dry Lab	EQ-201	Large Muffle Furnace	1	N/A	O/O	E	B	18"Wx18"D			
123	E16	Rock Sample Prep Dirty-Dry Lab	FH-04	ADA Fume Hood - 4'	1	115313	C/C	N	F	48"Wx36"Dx84"H	Kewaunee	H05_5448B00	Restricted-By-Pass
124	P09	Optics Teaching Lab	EQ-258	Optics Table	4	N/A	O/O	N	F	96"Wx48"Dx12"H	Technical Manufacturing Co.	CleanTop 784-655-02R	with 24" tie-bar leg set 14-426-35
124	P09	Optics Teaching Lab	EQ-259	ADA Optics Table	1	N/A	O/O	N	F	96"Wx48"Dx12"H	Manufacturing	02R	424-35
124	P09	Optics Teaching Lab	EQ-260	Optical Microscope	1	N/A	O/O	E	B	31"Wx19"Dx19"H	Olympus	SZ60 Stereo Optical Microscope	Not Located
124	P09	Optics Teaching Lab	FH-04	ADA Fume Hood - 4'	1	115313	C/C	N	F	48"Wx36"Dx84"H	Kewaunee	H05_5448B00	Restricted-By-Pass
125	E14	Historical, Soft Rock Geology Large Prep / Stg Room											
127	E05	Historical / Soft Rock Teaching Lab	FH-02	ADA Fume Hood - 6'	1	115313	C/C	N	F	72"Wx36"Dx84"H	Kewaunee	H08_5472B00	Restricted-By-Pass
133	P07-1	Imaging Room	EQ-255	Optics Table	1	N/A	O/O	N	F	144"Wx48"Dx18"H	Technical Manufacturing Co.	CleanTop 784-763-02R	with 18" tie-bar leg set 14-424-35
133	P07-1	Imaging Room	EQ-256	High Grade Astronomical Camera	3	N/A	O/O	E	B				
133	P07-1	Imaging Room	EQ-257	Multi-Channel Photon Correlator System	1	N/A	O/O	E	B				
135	P02	Synthesis & Electrical Characterization R.T. Lab	EQ-045	Glove Box	1	N/A	O/O	N	F	83"Wx32"Dx60"H	M. Braun	Unilab	Requires Compressed Air & Cooling water hookup
135	P02	Synthesis & Electrical Characterization R.T. Lab	EQ-046	Glove Box Purifier	1	N/A	O/O	N	F		M. Braun		
135	P02	Synthesis & Electrical Characterization R.T. Lab	EQ-047	Glove Box Vacuum Pump	1	N/A	O/O	N	F		M. Braun		
135	P02	Synthesis & Electrical Characterization R.T. Lab	EQ-208	Furnace	1	N/A	O/O	E	B				Inside Fume Hood
135	P02	Synthesis & Electrical Characterization R.T. Lab	EQ-209	Equipment Rack	1	N/A	O/O	E	F				
135	P02	Synthesis & Electrical Characterization R.T. Lab	EQ-210	Cryo Cooler ARS Displex	1	N/A	O/O	E	B		APD Cryogenics Inc		On Cryocooler Table
135	P02	Synthesis & Electrical Characterization R.T. Lab	EQ-211	Cryo Cooler Table	1	N/A	O/O	E	F	36"Wx60"Dx48"H			
135	P02	Synthesis & Electrical Characterization R.T. Lab	EQ-212	Cryo Cooler Compressor	1	N/A	O/O	E	B		CTI-Cryogenics		On Cryocooler Table. Requires Cooling water hookup
135	P02	Synthesis & Electrical Characterization R.T. Lab	EQ-213	Cryo Cooler Vacuum Pump	1	N/A	O/O	E	B				On Cryocooler Table
135	P02	Synthesis & Electrical Characterization R.T. Lab	EQ-214	Cryo Cooler Control Board	1	N/A	O/O	E	B		Perkin-Elmer	Part #: 401-338-200, Serial #: 8182	On Cryocooler Table
135	P02	Synthesis & Electrical Characterization R.T. Lab	EQ-215	Cryostat	1	N/A	O/O	E	F		ARS		On Tripod Stand

Room Number	Program No.	Space Name	Equip No.	Description	Quantity	Spec. No.	Furnish / Install	New / Exist	Mounted	Size	Manuf.	Model No.	Remarks
135	P02	Synthesis & Electrical Characterization R.T. Lab	EQ-216	Cryostat Compressor	1	N/A	O/O	E	F	24"Wx24"Dx24"H	APD Cryogenics Inc	HC-4	
135	P02	Synthesis & Electrical Characterization R.T. Lab	EQ-217	Magnet	1	N/A	O/O	E	F	36"Wx36"Dx60"H	Harvey-Wells Corp.		2 Tons
135	P02	Synthesis & Electrical Characterization R.T. Lab	EQ-218	Electromagnet Power Supply	1	N/A	O/O	E	B		LakeShore	647	On Equipment Rack
135	P02	Synthesis & Electrical Characterization R.T. Lab	EQ-219	Voltage / Current Source	1	N/A	O/O	E	B		Keithley	228A	On Equipment Rack
135	P02	Synthesis & Electrical Characterization R.T. Lab	EQ-220	Sensitive Digital Voltmeter	1	N/A	O/O	E	B		Keithley	182	On Equipment Rack
135	P02	Synthesis & Electrical Characterization R.T. Lab	EQ-221	Programmable Current Source	1	N/A	O/O	E	B		Keithley	228	On Equipment Rack
135	P02	Synthesis & Electrical Characterization R.T. Lab	EQ-222	(Unidentified Item)	1	N/A	O/O	E	B		LakeShore		On Equipment Rack
135	P02	Synthesis & Electrical Characterization R.T. Lab	EQ-223	Switch System	1	N/A	O/O	E	B		Keithley	7001	On Equipment Rack
135	P02	Synthesis & Electrical Characterization R.T. Lab	EQ-224	Multimeter	1	N/A	O/O	E	B		Keithley	2001	On Equipment Rack
135	P02	Characterization R.T. Lab	EQ-225	DC Power Supply	1	N/A	O/O	E	B			1630	On Equipment Rack
135	P02	Synthesis & Electrical Characterization R.T. Lab	EQ-226	Autoranging Multimeter	1	N/A	O/O	E	B		Keithley	175	On Equipment Rack
135	P02	Synthesis & Electrical Characterization R.T. Lab	EQ-227	Temperature Controller	1	N/A	O/O	E	B		Scientific Instruments Inc.	9620-1	On Equipment Rack
135	P02	Synthesis & Electrical Characterization R.T. Lab	EQ-228	Tube Furnace	1	N/A	O/O	E	B	24"Wx18"Dx24"H	Blue M	HTF55322A	
135	P02	Synthesis & Electrical Characterization R.T. Lab	FH-02	ADA Fume Hood - 6'	1	115313	C/C	N	F	72"Wx36"Dx84"H	Kewaunee	H08_5472B00	Restricted-By-Pass
137		Tank Storage	EQ-373	Cylinder Supports	1	123553	C/C	N	WL				
139	P06	Generic Physics R.T. Lab	EQ-376	Future DI Water Polisher	1	N/A	O/O	N	IC	13"Wx15"Dx20"H	Millipore	Milli-Q Advantage	with Q-POD
139	P06	Generic Physics R.T. Lab	FH-02	ADA Fume Hood - 6'	1	115313	C/C	N	F	72"Wx36"Dx84"H	Kewaunee	H08_5472B00	Restricted-By-Pass
141	P05	Photonics R.T. Lab	EQ-250	Large Laser Table	1	N/A	O/O	N	F	144"Wx59"Dx12"H	Technical Manufacturing Co.	CleanTop 784-676-02R	with 24" tie-bar leg set 14-426-35
141	P05	Photonics R.T. Lab	EQ-251	Small Laser Table	1	N/A	O/O	N	F	72"Wx59"Dx12"H	Technical Manufacturing Co.	CleanTop 784-671-02R	with 24" tie-bar leg set 14-426-35
141	P05	Photonics R.T. Lab	EQ-252	Titanium Sapphire Laser	1	N/A	O/O	E	B		Swartz Electro-Opticl	Ti: Sapphire standing-wave laser	Class IV Laser. Requires Cooling water hookup
141	P05	Photonics R.T. Lab	EQ-253	Argon-Ion Laser	1	N/A	O/O	E	B		Lexel	95-L 5 watt	Class IV Laser. Requires Cooling water hookup
141	P05	Photonics R.T. Lab	EQ-403	Large Laser Table	1	N/A	O/O	E	F	144"Wx59"Dx12"H			
141	P05	Photonics R.T. Lab	EQ-404	Small Laser Table	1	N/A	O/O	E	F	72"Wx59"Dx12"H			
141	P05	Photonics R.T. Lab	FH-04	ADA Fume Hood - 4'	1	115313	C/C	N	F	48"Wx36"Dx84"H	Kewaunee	H05_5448B00	Restricted-By-Pass
203	V02	Generic Environ. R.T. Lab	EQ-024	(4°C) Refrigerator	1	N/A	O/O	N	F	36"Wx34"Dx70"H			
203	V02	Generic Environ. R.T. Lab	EQ-076	Oven	1	N/A	O/O	N	B				

Room Number	Program No.	Space Name	Equip No.	Description	Quantity	Spec. No.	Furnish / Install	New / Exist	Mounted	Size	Manuf.	Model No.	Remarks
203	V02	Generic Environ. R.T. Lab	EQ-340	Particle Size Distribution Analyzer	1	N/A	O/O	N	B		Horiba	Partica LA-950V2	
203	V02	Generic Environ. R.T. Lab	EQ-341	Freeze Dryer & Pump	1	N/A	O/O	N	F		Labconco	FreeZone 4.5	On Cart
203	V02	Generic Environ. R.T. Lab	EQ-343	Desiccator	2	N/A	O/O	N	B				
203	V02	Generic Environ. R.T. Lab	EQ-345	Muffle Furnace	4	N/A	O/O	N	B				
203	V02	Generic Environ. R.T. Lab	FH-01	Fume Hood - 6'	1	115313	C/C	N	F	72"Wx36"Dx84"H	Kewaunee	H05_5472B00	Restricted-By-Pass
203	V02	Generic Environ. R.T. Lab	FH-02	ADA Fume Hood - 6'	1	115313	C/C	N	F	72"Wx36"Dx84"H	Kewaunee	H08_5472B00	Restricted-By-Pass
209	V09	Freezers Room	EQ-005	Ice Maker	1	115360	C/C	N	F	36"Wx24"Dx39"H	Hoshizaki	F300BAF	Water Cooled
209	V09	Freezers Room	EQ-024	(4°C) Refrigerator	3	N/A	O/O	N	F	36"Wx34"Dx70"H			
209	V09	Freezers Room	EQ-030	Freezer	1	N/A	O/O	N	F	32"Wx31"Dx70"H			**On Standby power**
209	V09	Freezers Room	EQ-344	Chest Freezer	6	N/A	O/O	N	F	60"Wx29"Dx41"H			**On Standby power**
211	V01	Coastal & Marine Studies R.T. Lab	EQ-001	Glassware Washer (Flask Scrubber)	1	115319	C/C	N	F	24"Wx24"Dx34"H	Labconco	4420330	Undercounter
211	V01	Coastal & Marine Studies R.T. Lab	EQ-011	Local Exhaust for AA	1	Div 23	C/C	N	C				
211	V01	Coastal & Marine Studies R.T. Lab	EQ-024	(4°C) Refrigerator	1	N/A	O/O	N	F	36"Wx34"Dx70"H			
211	V01	Coastal & Marine Studies R.T. Lab	EQ-030	Freezer	1	N/A	O/O	N	F	32"Wx31"Dx70"H			
211	V01	Coastal & Marine Studies R.T. Lab	EQ-076	Oven	2	N/A	O/O	N	B				
211	V01	Coastal & Marine Studies R.T. Lab	EQ-099	Atomic Absorption Spectrophotometer (AA)	1	N/A	O/O	N	B		PerkinElmer	AAnalyst 800	With PC
211	V01	Coastal & Marine Studies R.T. Lab	EQ-332	Water Still	1	N/A	O/O	E	WL	29"Wx15"Dx54"H	Thermo Scientific	Mega-Pure G A	Not Located. Will stay in Jennings.
211	V01	Coastal & Marine Studies R.T. Lab	EQ-333	Acid Bath	1	N/A	O/O	N	B		Thermo Scientific		Inside Fume Hood
211	V01	Coastal & Marine Studies R.T. Lab	EQ-334	Mercury Analyzer, Controller, & Screen	1	N/A	O/O	E	B		Milestone	DMA-80	
211	V01	Coastal & Marine Studies R.T. Lab	EQ-335	Freeze Dryer & Pump	1	N/A	O/O	E	F		Labconco	FreeZone 4.5	On Cart
211	V01	Coastal & Marine Studies R.T. Lab	EQ-336	Vertical Clean Bench	1	N/A	O/O	E	B	24"Wx30"Dx42"H	Labconco	Purifier - Cat # 3970200	
211	V01	Coastal & Marine Studies R.T. Lab	EQ-337	Vertical Clean Bench	1	N/A	O/O	E	B	36"Wx30"Dx42"H	Labconco	Purifier	
211	V01	Coastal & Marine Studies R.T. Lab	EQ-338	Centrifuge	1	N/A	O/O	N	B				
211	V01	Coastal & Marine Studies R.T. Lab	EQ-339	Muffle Furnace	2	N/A	O/O	N	B				
211	V01	Coastal & Marine Studies R.T. Lab	EQ-377	DI Water Polishing System	1	N/A	O/O	E	B				
211	V01	Coastal & Marine Studies R.T. Lab	FH-01	Fume Hood - 6'	1	115313	C/C	N	F	72"Wx36"Dx84"H	Kewaunee	H05_5472B00	Restricted-By-Pass
211	V01	Coastal & Marine Studies R.T. Lab	FH-02	ADA Fume Hood - 6'	1	115313	C/C	N	F	72"Wx36"Dx84"H	Kewaunee	H08_5472B00	Restricted-By-Pass
211	V01	Coastal & Marine Studies R.T. Lab	FH-06	Perchloric Fume Hood - 6'	1	115313	C/C	N	F	72"Wx36"Dx84"H	Kewaunee	H25L5472-00	Open-By-Pass
211B		Tank Storage	EQ-373	Cylinder Supports	1	123553	C/C	N	WL				
211C		Tank Storage	EQ-373	Cylinder Supports	1	123553	C/C	N	WL				
214	S02	Shared Computer Lab	EQ-354	Computer Station	8	N/A	O/O	N	F				
214	S02	Shared Computer Lab	EQ-355	Printer	1	N/A	O/O	N	B				36" wide roll-fed inkjet
214	S02	Shared Computer Lab	EQ-356	Printer	1	N/A	O/O	N	B				Color Laser (11 x 17)
219	E12	Mineralogy Sample Storage Secure Room	EQ-364	File Cabinets	2	N/A	C/C	N	F				
221	E03	Mineralogy / Petrology Teaching Lab	EQ-161	Microscope	20	N/A	O/O	N	B	10"Wx17"Dx23"H			

Room Number	Program No.	Space Name	Equip No.	Description	Quantity	Spec. No.	Furnish / Install	New / Exist	Mounted	Size	Manuf.	Model No.	Remarks
221	E03	Mineralogy / Petrology Teaching Lab	FH-04	ADA Fume Hood - 4'	1	115313	C/C	N	F	48"Wx36"Dx84"H	Kewaunee	H05_5448B00	Restricted-By-Pass
223	E07	X-Ray Sample Prep Lab	EQ-004	DI Water Polisher	1	115360	C/C	N	IC	13"Wx15"Dx20"H	Millipore	Milli-Q Advantage	with Q-POD
223	E07	X-Ray Sample Prep Lab	EQ-024	(4°C) Refrigerator	1	N/A	O/O	N	F	36"Wx34"Dx70"H			
223	E07	X-Ray Sample Prep Lab	EQ-065	Analytical Balance	1	N/A	O/O	E	B				
223	E07	X-Ray Sample Prep Lab	EQ-072	Oven	1	N/A	O/O	E	B	24"Wx25"D			
223	E07	X-Ray Sample Prep Lab	EQ-168	Muffle Furnace	2	N/A	O/O	E	B	18"Wx18"D			Inside Fume Hood
223	E07	X-Ray Sample Prep Lab	EQ-169	Ultra Sonic Bath	1	N/A	O/O	E	B	14"Wx16"D			
223	E07	X-Ray Sample Prep Lab	EQ-170	Fusion System	1	N/A	O/O	E	B	36"Wx19"Dx19"H	Katanax		Electric. NO GAS
223	E07	X-Ray Sample Prep Lab	EQ-171	Mixer / Mill	1	N/A	O/O	E	B	22"Wx24"D	Spex Certiprep	8000M	
223	E07	X-Ray Sample Prep Lab	EQ-172	Hydraulic Press	1	N/A	O/O	E	B	16"Wx22"D	Specac		
223	E07	X-Ray Sample Prep Lab	EQ-173	Magnetic Separator	1	N/A	O/O	E	B	40"Wx26"D	Frantz		
223	E07	X-Ray Sample Prep Lab	FH-01	Fume Hood - 6'	1	115313	C/C	N	F	72"Wx36"Dx84"H	Kewaunee	H05_5472B00	Restricted-By-Pass
223	E07	X-Ray Sample Prep Lab	FH-04	ADA Fume Hood - 4'	1	115313	C/C	N	F	48"Wx36"Dx84"H	Kewaunee	H05_5448B00	Restricted-By-Pass
225	E06	X-Ray Analysis Lab	EQ-013	Vent Port	1	Div 23	C/C	N	C				
225	E06	X-Ray Analysis Lab	EQ-017	Horizontal Laminar Flow Hood Workstation-6' (Polypropylene)	1	N/A	O/O	N	F		Microzone	H6-MW-99C30	Non-vented
225	E06	X-Ray Analysis Lab	EQ-162	X-Ray Fluorescence Spectrometer	1	N/A	O/O	N	F	52"Wx35"Dx54"H	Rigaku	ZSX Primus II (or Panalytical Axios, or ThermoARL Advant'X)	3 or 4 KW tube. Requires Cooling water hookup
225	E06	X-Ray Analysis Lab	EQ-162a	Computer Station for (X-Ray Fluorescence Spectrometer, EQ-162)	1	N/A	O/O	N	F	26"Wx30"Dx54"H	Rigaku		
225	E06	X-Ray Analysis Lab	EQ-162b	Ion Exchange Assembly for (X-Ray Fluorescence Spectrometer, EQ-162)	1	N/A	O/O	N	WL		Rigaku		
225	E06	X-Ray Analysis Lab	EQ-162c	Water Chiller for (X-Ray Fluorescence Spectrometer, EQ-162)	1	N/A	O/O	N	F	27"Wx26"Dx35"H	Haskris	R175W	
225	E06	X-Ray Analysis Lab	EQ-163	X-Ray Diffractometer	1	N/A	O/O	E	B	22"Wx15"Dx26"H	Rigaku	Miniflex II	Requires Cooling water hookup
225	E06	X-Ray Analysis Lab	EQ-163a	PC, Monitor & Printer for (X-Ray Diffractometer, EQ-163)	1	N/A	O/O	E	B				
225	E06	X-Ray Analysis Lab	EQ-163b	Chiller for (X-Ray Diffractometer, EQ-163)	1	N/A	O/O	E	F	14"Wx16"D	Haskis	HAS-WA1-60	
225	E06	X-Ray Analysis Lab	EQ-164	X-Ray Fluorescence Analytical Microscope (Micro XRF)	1	N/A	O/O	N	B	72"Wx40"Dx30"H	Horiba	XGT-7000 (or EDAX Orbis)	1.3 kva. Requires Liq. N2 hookup
225	E06	X-Ray Analysis Lab	EQ-164a	X-Ray Controller for (Micro XRF, EQ-164)	1	N/A	O/O	N	B	Part of (EQ-164)	Horiba		
225	E06	X-Ray Analysis Lab	EQ-164b	X-Ray Stage Controller for (Micro XRF, EQ-164)	1	N/A	O/O	N	B	Part of (EQ-164)	Horiba		
225	E06	X-Ray Analysis Lab	EQ-164c	PC, Monitor & Printer for (Micro XRF, EQ-164)	1	N/A	O/O	N	B	Part of (EQ-164)			
225	E06	X-Ray Analysis Lab	EQ-164d	Vacuum Pump for (Micro XRF, EQ-164)	1	N/A	O/O	N	IC	Part of (EQ-164)			
225	E06	X-Ray Analysis Lab	EQ-165	X-Ray Chiller	1	N/A	O/O	N	F				
225	E06	X-Ray Analysis Lab	EQ-167	Desiccator Cabinet	4	N/A	O/O	E	B				

Room Number	Program No.	Space Name	Equip No.	Description	Quantity	Spec. No.	Furnish / Install	New / Exist	Mounted	Size	Manuf.	Model No.	Remarks
226	E02b	Generic Earth Sci R.T. Lab	FH-05	Future Fume Hood - 4'	1	115313	C/C	N	F	48"Wx36"Dx84"H	Kewaunee	H05_5448B00	Restricted-By-Pass
227		Tank Storage	EQ-145	Liquid Nitrogen Tank	1	N/A	O/O	E	F				
229	E08	Laser Ablation, ICP-MS Lab	EQ-013	Vent Port	2	Div 23	C/C	N	C				
229	E08	Laser Ablation, ICP-MS Lab	EQ-017	Horizontal Laminar Flow Hood Workstation-6' (Polypropylene)	1	N/A	O/O	N	F		Microzone	H6-MW-99C30	Non-Vented
229	E08	Laser Ablation, ICP-MS Lab	EQ-174	ICP-MS Magnetic Sector field	1	N/A	O/O	N	F		Thermo-Finnigan	Element 2XR	Requires Cooling water hookup
229	E08	Laser Ablation, ICP-MS Lab	EQ-175	ICP-MS Laser Ablation System	1	N/A	O/O	N	F		NewWave	213 nm	Requires Cooling water hookup
229	E08	Laser Ablation, ICP-MS Lab	EQ-176	ICP-MS Water Chiller	1	N/A	O/O	N	F				
229	E08	Laser Ablation, ICP-MS Lab	EQ-365	Liquid Argon Dewar	1	N/A	O/O	E	F				
229	E08	Laser Ablation, ICP-MS Lab	FH-11	Vertical Laminar Flow Hood - 4' (Polypropylene)	1	115313	C/C	N	F	49"Wx36"Dx68"H	NuAire	FumeGard NU-156-424	
230	E02c	Generic Earth Sci R.T. Lab	FH-05	Future Fume Hood - 4'	1	115313	C/C	N	F	48"Wx36"Dx84"H	Kewaunee	H05_5448B00	Restricted-By-Pass
233A	E09	Clean Geo Chemistry Lab	EQ-004	DI Water Polisher	1	115360	C/C	N	IC	13"Wx15"Dx20"H	Millipore	Milli-Q Advantage	with Q-POD
233A	E09	Clean Geo Chemistry Lab	EQ-006	Pass-Through Box	1	115360	C/C	N	WL	24"Wx24"Dx24"H	G2 Automated Technologies	EPPT-POLY-SCPT006	
233A	E09	Clean Geo Chemistry Lab	EQ-068	Analytical Balance	1	N/A	O/O	N	B		Denver Instrument		
233A	E09	Clean Geo Chemistry Lab	FH-08	Perchloric Fume Hood - 4' (Polypropylene)	1	115313	C/C	N	F	48"Wx30"Dx59"H	AirMax	AC4030TE	with Scrubber
233A	E09	Clean Geo Chemistry Lab	FH-10	Vertical Laminar Flow Hood - 6' (Polypropylene)	3	115313	C/C	N	F	73"Wx36"Dx68"H	NuAire	FumeGard NU-156-624	
233B	E09-1	Clean Geo Chem Vestibule / Gowning											
234	E02d	Generic Earth Sci R.T. Lab	FH-05	Future Fume Hood - 4'	1	115313	C/C	N	F	48"Wx36"Dx84"H	Kewaunee	H05_5448B00	Restricted-By-Pass
235	E10	General Geo Chem Student R.T. Lab	EQ-004	DI Water Polisher	1	115360	C/C	N	IC	13"Wx15"Dx20"H	Millipore	Milli-Q Advantage	with Q-POD
235	E10	General Geo Chem Student R.T. Lab	EQ-068	Analytical Balance	2	N/A	O/O	N	B		Denver Instrument		
235	E10	General Geo Chem Student R.T. Lab	FH-03	Fume Hood - 4'	1	115313	C/C	N	F	48"Wx36"Dx84"H	Kewaunee	H05_5448B00	Restricted-By-Pass
235	E10	General Geo Chem Student R.T. Lab	FH-04	ADA Fume Hood - 4'	1	115313	C/C	N	F	48"Wx36"Dx84"H	Kewaunee	H05_5448B00	Restricted-By-Pass
237	E01	Cathodoluminescence / Fluid Inclusion R.T. Lab	EQ-079	Vacuum Pump	1	N/A	O/O	E	IC				Inside cabinet
237	E01	Cathodoluminescence / Fluid Inclusion R.T. Lab	EQ-145	Liquid N2 Dewar	1	N/A	O/O	E	F				
237	E01	Cathodoluminescence / Fluid Inclusion R.T. Lab	EQ-157	Cathodoluminescence Microscope	1	N/A	O/O	E	B	60"W	Nuclide		
237	E01	Cathodoluminescence / Fluid Inclusion R.T. Lab	EQ-158	Raman Microscope	1	N/A	O/O	N	B				Not Located
237	E01	Cathodoluminescence / Fluid Inclusion R.T. Lab	EQ-159	Polarization Microscope	1	N/A	O/O	N	B		Leica	DMLP	Attach to existing cathodoluminescence and fluid inclusion equipment (How?)
237	E01	Cathodoluminescence / Fluid Inclusion R.T. Lab	EQ-160	Fluid Inclusion Microscope	1	N/A	O/O	E	B	60"W	Linkam		
239	E02a	Generic Earth Sci R.T. Lab	FH-04	ADA Fume Hood - 4'	1	115313	C/C	N	F	48"Wx36"Dx84"H	Kewaunee	H05_5448B00	Restricted-By-Pass
241	E04-1	Structural Geology Sample Storage	EQ-364	File Cabinets	2	N/A	C/C	N	F				

Room Number	Program No.	Space Name	Equip No.	Description	Quantity	Spec. No.	Furnish / Install	New / Exist	Mounted	Size	Manuf.	Model No.	Remarks
241A	E13	Structural Geology Field Equipment Storage Room	EQ-177	Ground Penetration Radar (GPR)	1	N/A	O/O	E	B		Mala		On Cart. Not Located
241A	E13	Structural Geology Field Equipment Storage Room	EQ-178	Magnetometer	1	N/A	O/O	E	B		Geometrics		Not Located
241A	E13	Structural Geology Field Equipment Storage Room	EQ-179	Ground Conductivity Meter	1	N/A	O/O	N	B				Not Located
241A	E13	Structural Geology Field Equipment Storage Room	EQ-180	Resistivity Array	1	N/A	O/O	N	B				Not Located
241A	E13	Structural Geology Field Equipment Storage Room	EQ-181	Vibracorer	1	N/A	O/O	N	B				Not Located
241A	E13	Structural Geology Field Equipment Storage Room	EQ-182	12 Channel Seismic Array	1	N/A	O/O	N	B				Not Located
241A	E13	Structural Geology Field Equipment Storage Room	EQ-183	Gravity Meter	1	N/A	O/O	N	B				Not Located
243	E04	Structural Geology Teaching Lab	FH-02	ADA Fume Hood - 6'	1	115313	C/C	N	F	72"Wx36"Dx84"H	Kewaunee	H08_5472B00	Restricted-By-Pass
305	B02	Molecular Biology R.T. Lab	EQ-025	Chromatography Refrigerator	1	N/A	O/O	N	F		Thermo Scientific Revco	13-990-317 No. RCR4304A	Sliding glass doors, 8 shelves
305	B02	Molecular Biology R.T. Lab	EQ-031	(-20°C) Freezer	1	N/A	O/O	N	F				**On Standby power**
305	B02	Molecular Biology R.T. Lab	EQ-040	Air Incubator	3	N/A	O/O	N	F				
305	B02	Molecular Biology R.T. Lab	EQ-136	Clinical Centrifuge	1	N/A	O/O	N	B	20"Wx23"Dx14"H	Thermo Scientific	Sorvall Primo R 75005448	Refrigerated
305	B02	Molecular Biology R.T. Lab	EQ-137	Coulter Counter	1	N/A	O/O	N	B	11"Wx15"Dx18"H	VWR	BK6605700 Z2 Analyzer 6605700v	
305	B02	Molecular Biology R.T. Lab	EQ-138	UV-Cross Linker	1	N/A	O/O	N	B				Stacked
305	B02	Molecular Biology R.T. Lab	EQ-139	UV-Vis Spec.	1	N/A	O/O	N	B				Stacked
305	B02	Molecular Biology R.T. Lab	EQ-140	Water Bath	2	N/A	O/O	N	B		Thermo Scientific	Fisher Isotemp 215 Dual Chamber	
305	B02	Molecular Biology R.T. Lab	EQ-141	Speed Vac Centrifuge	1	N/A	O/O	N	B				
305	B02	Molecular Biology R.T. Lab	EQ-142	Micro Centrifuge	2	N/A	O/O	N	B		Eppendorf		
305	B02	Molecular Biology R.T. Lab	EQ-143	Compound Microscope	4	N/A	O/O	N	B				
305	B02	Molecular Biology R.T. Lab	EQ-376	Future DI Water Polisher	1	N/A	O/O	N	IC	13"Wx15"Dx20"H	Millipore	Milli-Q Advantage	with Q-POD
305	B02	Molecular Biology R.T. Lab	EQ-379	Thermocycler	1	N/A	O/O	N	B				
305	B02	Molecular Biology R.T. Lab	EQ-380	Incubating Shaker	1	N/A	O/O	N	B		Thermo Scientific	14-728-2	
305	B02	Molecular Biology R.T. Lab	EQ-381	L-Series Incubator Shaker Univ. Platform	1	N/A	O/O	N	B		Thermo Scientific	14-278-42	
305	B02	Molecular Biology R.T. Lab	EQ-382	Accessory Flask Clamps - 2 liter	4	N/A	O/O	N	B		Thermo Scientific	14-281-27	
305	B02	Molecular Biology R.T. Lab	EQ-383	Accessory Flask Clamps - 1 liter	4	N/A	O/O	N	B		Thermo Scientific	14-281-26	
305	B02	Molecular Biology R.T. Lab	EQ-384	Accessory Flask Clamps - 125 ml	10	N/A	O/O	N	B		Thermo Scientific	14-278-161	
305	B02	Molecular Biology R.T. Lab	EQ-393	Drum Rotor	1	N/A	O/O	N	B	80 x 1.5/2 ml	Thermo Scientific	75007595	
305	B02	Molecular Biology R.T. Lab	EQ-394	PCR strips with 8 tubes rack / Nature	1	N/A	O/O	N	B		Thermo Scientific	76001587	

Room Number	Program No.	Space Name	Equip No.	Description	Quantity	Spec. No.	Furnish / Install	New / Exist	Mounted	Size	Manuf.	Model No.	Remarks
305	B02	Molecular Biology R.T. Lab	EQ-395	Microliter tubes rack / Red	8	N/A	O/O	N	B	1.5/2 ml	Thermo Scientific	76001244	
305	B02	Molecular Biology R.T. Lab	EQ-396	Fixed-Angle Highconic Rotor with Cover	1	N/A	O/O	N	B	6 x 50 ml	Thermo Scientific	75007588	
305	B02	Molecular Biology R.T. Lab	EQ-397	Disposable Conocal Adaptor for EQ-396	6	N/A	O/O	N	B	15 ml	Thermo Scientific	75003095	
305	B02	Molecular Biology R.T. Lab	EQ-398	Swinging Bucket Rotor	1	N/A	O/O	N	B	4 x 100 ml	Thermo Scientific	75007591	
305	B02	Molecular Biology R.T. Lab	EQ-399	Disposable Conocal Adaptor for EQ-398	4	N/A	O/O	N	B	50 ml	Thermo Scientific	75007557	
305	B02	Molecular Biology R.T. Lab	EQ-400	Disposable Conocal Adaptor for EQ-398	4	N/A	O/O	N	B	15 ml	Thermo Scientific	75007556	
305	B02	Molecular Biology R.T. Lab	EQ-401	Round Buckets	4	N/A	O/O	N	B		Thermo Scientific	75007555	
305	B02	Molecular Biology R.T. Lab	EQ-402	Aerosol-Tight Cap	4	N/A	O/O	N	B		Thermo Scientific	75007598	
305	B02	Molecular Biology R.T. Lab	FH-03	Fume Hood - 4'	1	115313	C/C	N	F	48"Wx36"Dx84"H	Kewaunee	H05_5448B00	Restricted-By-Pass
305	B02	Molecular Biology R.T. Lab	FH-04	ADA Fume Hood - 4'	1	115313	C/C	N	F	48"Wx36"Dx84"H	Kewaunee	H05_5448B00	Restricted-By-Pass
310	S06	Growth Chamber	EQ-009	Pre-Fabricated Growth Chamber Unit	1	132420	C/C	N	F		EGC	M75	Water Cooled Condensing Unit
310	S06-1	Reach-In Growth Chambers Room	EQ-010	Reach-In Growth Chamber Unit	2	132420	C/C	N	F	34"Wx34"Dx73"H	Percival	E-36L1	
311A	B09	Molecular Biology Microscope Room	EQ-152	LSCM Confocal Microscope	1	N/A	O/O	N	B				
311A	B09	Molecular Biology Microscope Room	EQ-153	DSU Spinning Disk Confocal Microscope	1	N/A	O/O	N	B		Perkin Elmer		
311F	B10	Molecular Biology Cold Room	EQ-008	Controlled Environmental Room	1	132420	C/C	N	F		Thermmax	(4º C) Cold Room	Water Cooled Condensing Unit
311F	B10	Molecular Biology Cold Room	EQ-155	Centrifuge	2	N/A	O/O	N	B				
311F	B10	Molecular Biology Cold Room	EQ-156	Coolers with frozen plants and soil.	2	N/A	O/O	N	F				
312	B01	Microbiology R.T. Lab	EQ-020	BioSafety Cabinet - Type II A2 - 4'	2	N/A	O/O	N	F	54"Wx33"Dx95"H	NuAire	NU-425-400	Non-Ducted
312	B01	Microbiology R.T. Lab	EQ-026	Chromatography Refrigerator	1	N/A	O/O	N	F	27 cu ft.	Fisher Isotemp	13-986-127GA	From B01
312	B01	Microbiology R.T. Lab	EQ-032	(-20° C) Freezer	1	N/A	O/O	N	F	5 cu ft.	Thermo Scientific	REF417A	From B01
312	B01	Microbiology R.T. Lab	EQ-038	Still Incubator (27°C & 37°C)	2	N/A	O/O	N	B	3.4 cu ft.	Fisher Isotemp	3.4 cu ft (625F)	
312	B01	Microbiology R.T. Lab	EQ-039	Shaking Incubator (27°C & 37°C)	1	N/A	O/O	E	B				Moved from JE 331
312	B01	Microbiology R.T. Lab	EQ-126	Water Bath	2	N/A	O/O	N	B		Fisher Isotemp	Dual Chamber	
312	B01	Microbiology R.T. Lab	EQ-127	Fluorometer	1	N/A	O/O	N	B	5"Wx8"Dx3"H	Hoefer	DQ300	
312	B01	Microbiology R.T. Lab	EQ-128	Spectrophotometer	1	N/A	O/O	N	B	16"Wx12"Dx7"H	United Products	1200	
312	B01	Microbiology R.T. Lab	EQ-129	Electroporator	1	N/A	O/O	N	B	11"Wx9"Dx4"H	Eppendorf	2510 (940000602)	
312	B01	Microbiology R.T. Lab	EQ-130	Spiral Plater	1	N/A	O/O	N	B	20"Wx16"Dx13"H	Neutec	1701	
312	B01	Microbiology R.T. Lab	EQ-131	Laser Colony Counter	1	N/A	O/O	N	B	7"Wx9"Dx14"H	Neutec	6010	
312	B01	Microbiology R.T. Lab	EQ-132	Microcentrifuge	1	N/A	O/O	N	B	9"Wx10"Dx14"H	Fisher Accuspin	Micro17R	
312	B01	Microbiology R.T. Lab	EQ-133	Thermocycler	1	N/A	O/O	N	B	10"Wx16"Dx12"H	Thermo Scientific	HBPXE02110	
312	B01	Microbiology R.T. Lab	EQ-134	Sonicator	1	N/A	O/O	N	B	12"Wx16"Dx15"H	Branson	15-337-22H	

Room Number	Program No.	Space Name	Equip No.	Description	Quantity	Spec. No.	Furnish / Install	New / Exist	Mounted	Size	Manuf.	Model No.	Remarks
312	B01	Microbiology R.T. Lab	EQ-135	Computer	2	N/A	O/O	N	B		Macintosh	iMac	
312	B01	Microbiology R.T. Lab	FH-04	ADA Fume Hood - 4'	1	115313	C/C	N	F	48"Wx36"Dx84"H	Kewaunee	H05_5448B00	Restricted-By-Pass
313	S07	Autoclave Room (Decontamination)	EQ-003	Autoclave	1	115319	C/C	N	F	28"Lx34"Wx74"H	Getinge	GE-633LS	W/ Integral steam generator
313	S07	Autoclave Room (Decontamination)	EQ-012	Exhaust Canopy	1	Div 23	C/C	N	C				
313A	S09	Media Prep, Glass Wash & Sterilization Autoclave	EQ-002	Glassware Washer / Dryer	1	115319	C/C	N	F	36"Wx44"Dx80"H	Lancer	Labexia 1700 LXA	Free Standing
313A	S09	Media Prep, Glass Wash & Sterilization Autoclave	EQ-003	Autoclave	1	115319	C/C	N	F	28"Lx34"Wx74"H	Getinge	GE-633LS	W/ Integral steam generator
313A	S09	Media Prep, Glass Wash & Sterilization Autoclave	EQ-004	DI Water Polisher	1	115360	C/C	N	WL	13"Wx15"Dx20"H	Millipore	Milli-Q Advantage	with Q-POD
313A	S09	Media Prep, Glass Wash & Sterilization Autoclave	EQ-005	Ice Maker	1	115360	C/C	N	F	36"Wx24"Dx39"H	Hoshizaki	F300BAF	Water Cooled
313A	S09	Media Prep, Glass Wash & Sterilization Autoclave	EQ-012	Exhaust Canopy	1	Div 23	C/C	N	C				
314	B04	(CCRI) Tissue Culture Room	EQ-019	BioSafety Cabinet - Type II A2 - 6'	3	N/A	O/O	N	F	78"Wx33"Dx95"H	NuAire	NU-425-600	Non-Ducted
314	B04	(CCRI) Tissue Culture Room	EQ-024	(4°C) Refrigerator	1	N/A	O/O	N	F	36"Wx34"Dx70"H			
314	B04	(CCRI) Tissue Culture Room	EQ-034	Liquid N2 Freezer	1	N/A	O/O	N	F				
314	B04	(CCRI) Tissue Culture Room	EQ-041	CO2 Incubator	4	N/A	O/O	N	F				
314	B04	(CCRI) Tissue Culture Room	EQ-144	Microscope	1	N/A	O/O	N	B				
314	B04	(CCRI) Tissue Culture Room	EQ-145	Liquid N2 Dewar	1	N/A	O/O	N	F				
315	C01	Biochemistry R.T. Lab	EQ-004	DI Water Polisher	1	115360	C/C	N	IC	13"Wx15"Dx20"H	Millipore	Milli-Q Advantage	with Q-POD
315	C01	Biochemistry R.T. Lab	EQ-019	BioSafety Cabinet - Type II A2 - 6'	2	N/A	O/O	N	F	78"Wx33"Dx95"H	NuAire	NU-425-600	Non-Ducted
315	C01	Biochemistry R.T. Lab	EQ-021	Refrigerator (Undercounter)	1	N/A	O/O	E	F	19"Wx20"Dx34"H	Sanyo	SR-3620/SR-3660	**On Standby power**
315	C01	Biochemistry R.T. Lab	EQ-027	(-20°) Freezer	1	N/A	O/O	E	F		American Scientific Products Revco	SY 88326	**On Standby power**
315	C01	Biochemistry R.T. Lab	EQ-028	(-70°) Freezer	1	N/A	O/O	E	F	29"Wx27"Dx46"H	Revco GS Laboratory Equipment	ULT 390-5-A31	**On Standby power**
315	C01	Biochemistry R.T. Lab	EQ-036	Incubator	1	N/A	O/O	E	F		Lab-Line Instruments	3528	**On Standby power**
315	C01	Biochemistry R.T. Lab	EQ-037	Incubator (Roll-In)	1	N/A	O/O	E	F		BellCo Glass Biotechnology	Cat# 7728-06005 Serial# MRPO-53	**On Standby power**
315	C01	Biochemistry R.T. Lab	FH-01	Fume Hood - 6'	1	115313	C/C	N	F	72"Wx36"Dx84"H	Kewaunee	H05_5472B00	Restricted-By-Pass
315	C01	Biochemistry R.T. Lab	FH-02	ADA Fume Hood - 6'	1	115313	C/C	N	F	72"Wx36"Dx84"H	Kewaunee	H08_5472B00	Restricted-By-Pass
315B		Tank Storage											
322	B08	(CCRI) Histology Room	EQ-148	Microtome	3	N/A	O/O	N	B		Leica	EM UC7/FC7	
322	B08	(CCRI) Histology Room	EQ-149	Water Bath	1	N/A	O/O	N	B				
322	B08	(CCRI) Histology Room	EQ-150	Microscope	2	N/A	O/O	N	B				
322	B08	(CCRI) Histology Room	EQ-151	Centrifuge - Regular Speed	1	N/A	O/O	N	B		Sorvall		
322	B08	(CCRI) Histology Room	FH-02	ADA Fume Hood - 6'	1	115313	C/C	N	F	72"Wx36"Dx84"H	Kewaunee	H08_5472B00	Restricted-By-Pass
324	B07	(CCRI) Microscopy Room	EQ-146	Microscope	4	N/A	O/O	N	B				
325	C08	Inorganic Chem Teaching Lab	EQ-023	Refrigerator	1	N/A	O/O	E	F	16.7 Cu. Ft.	Fisher Scientific	NC9036828	

Room Number	Program No.	Space Name	Equip No.	Description	Quantity	Spec. No.	Furnish / Install	New / Exist	Mounted	Size	Manuf.	Model No.	Remarks
325	C08	Inorganic Chem Teaching Lab	EQ-058	Rotovap	4	N/A	O/O	N	B	22"Wx17"Dx23"H	Buchi	R-215 Basic	
325	C08	Inorganic Chem Teaching Lab	EQ-059	Rotovap -Vacuum Pump	4	N/A	O/O	N	B	13"Wx8"Dx8"H	Gast Manuf. Corp.	Standard	
325	C08	Inorganic Chem Teaching Lab	EQ-060	Solvent Purification System	1	N/A	O/O	N	F	43"Wx29"Dx77"H	Innovative Technology, Inc.	PureSolv MD 5	
325	C08	Inorganic Chem Teaching Lab	EQ-061	Vacuum Pump for Solvent Purification System	1	N/A	O/O	N	F	7"Wx13"Dx9"H	Welch	Dryfast Solid PTFE 2044	
325	C08	Inorganic Chem Teaching Lab	EQ-064	Balance	4	N/A	O/O	E	B	8"Wx18"Dx12"H	Ohaus		
325	C08	Inorganic Chem Teaching Lab	EQ-075	Drying Glass Oven	2	N/A	O/O	N	B	24"Wx26"Dx26"H	Fischer Scientific	Isotemp Small	
325	C08	Inorganic Chem Teaching Lab	EQ-078	Vacuum Pump	6	N/A	O/O	E	IC	7"Wx19"Dx17"H	Edwards	RV5	Inside cabinet under hood
325	C08	Inorganic Chem Teaching Lab	EQ-374	Rotovap -Chiller	2	N/A	O/O	E	IC				Inside cabinet.
325	C08	Inorganic Chem Teaching Lab	FH-01	Fume Hood - 6'	5	115313	C/C	N	F	72"Wx36"Dx84"H	Kewaunee	H05_5472B00	Restricted-By-Pass
325	C08	Inorganic Chem Teaching Lab	FH-02	ADA Fume Hood - 6'	1	115313	C/C	N	F	72"Wx36"Dx84"H	Kewaunee	H08_5472B00	Restricted-By-Pass
327	C09	Inorganic Chem Prep Lab	EQ-005	Ice Maker	1	115360	C/C	N	F	36"Wx24"Dx39"H	Hoshizaki	F300BAF	Water Cooled
327	C09	Inorganic Chem Prep Lab	EQ-043	Glove Box	1	N/A	O/O	E	F	80"Wx32"Dx76"H	Vacuum Atmospheres Company	Nexus VAC 100031	**On Standby power**
327	C09	Inorganic Chem Prep Lab	EQ-044	Glove Box Vacuum Pump	1	N/A	O/O	E	F	20"Wx5"Dx8"H	Leybold Trivac	D4A	
327	C09	Inorganic Chem Prep Lab	EQ-067	Magnetic Balance	1	N/A	O/O	N	B	9"Wx12"Dx6"H	Johnson Matthey	Mark I	
327	C09	Inorganic Chem Prep Lab	EQ-114	Dry Ice Box	1	N/A	O/O	E	B				
327	C09	Inorganic Chem Prep Lab	EQ-115	UV Light (TLC)	2	N/A	O/O	E	B				
327	C09	Inorganic Chem Prep Lab	EQ-116	Melting Points	3	N/A	O/O	E	B				
327	C09	Inorganic Chem Prep Lab	EQ-362	Small N2 Dewar	1	N/A	O/O	E	B				
327	C09	Inorganic Chem Prep Lab	EQ-363	Solvent Drum	4	N/A	O/O	E	B	5 Gallons			
327B		Tank Storage	EQ-249	Toxic Gas Cylinder Storage Cabinet	1	123554	C/C	N	F	26"Wx19"Dx79"H	Matheson Trigas	1178F	Located inside tank storage closet
328	P18-1	Rooftop Astronomy Control Room	EQ-330	Computer Station	4	N/A	O/O	E	F				
328	P18-1	Rooftop Astronomy Control Room	EQ-331	Printer	1	N/A	O/O	N	B				
329	C03	Inorganic R.T. Lab	EQ-022	Refrigerator	1	N/A	O/O	E	F	16.7 Cu. Ft.	Fisher Scientific	NC9036828	
329	C03	Inorganic R.T. Lab	EQ-055	Rotovap	1	N/A	O/O	E	F	22"Wx17"Dx23"H	Buchi	R-215 Basic	
329	C03	Inorganic R.T. Lab	EQ-071	Drying Oven	2	N/A	O/O	E	B	24"Wx26"Dx26"H	Fischer Scientific	Isotemp Small	
329	C03	Inorganic R.T. Lab	EQ-082	Vacuum Pump	3	N/A	O/O	N	IC	13"Wx8"Dx8"H	Gast Manuf. Corp.	Standard	Inside cabinet under hood.
329	C03	Inorganic R.T. Lab	FH-01	Fume Hood - 6'	2	115313	C/C	N	F	72"Wx36"Dx84"H	Kewaunee	H05_5472B00	Restricted-By-Pass
329	C03	Inorganic R.T. Lab	FH-02	ADA Fume Hood - 6'	1	115313	C/C	N	F	72"Wx36"Dx84"H	Kewaunee	H08_5472B00	Restricted-By-Pass
331	C04	Physical Chem R.T. Lab	EQ-103	Air Compressor for NMR	1	N/A	O/O	E	F				C11
331	C04	Physical Chem R.T. Lab	FH-02	ADA Fume Hood - 6'	1	115313	C/C	N	F	72"Wx36"Dx84"H	Kewaunee	H08_5472B00	Restricted-By-Pass
332	S03	Shared Equipment Lab	EQ-005	Ice Maker	1	115360	C/C	N	F	36"Wx24"Dx39"H	Hoshizaki	F300BAF	Water Cooled
332	S03	Shared Equipment Lab	EQ-024	(4°C) Refrigerator	1	N/A	O/O	N	F	36"Wx34"Dx70"H			

Room Number	Program No.	Space Name	Equip No.	Description	Quantity	Spec. No.	Furnish / Install	New / Exist	Mounted	Size	Manuf.	Model No.	Remarks
332	S03	Shared Equipment Lab	EQ-031	(-20°C) Freezer	1	N/A	O/O	N	F				**On Standby power**
332	S03	Shared Equipment Lab	EQ-033	(-40°C to -86°C) Chest Freezer	2	N/A	O/O	N	F		Thermo Scientific Revco Elite Ultra-Low	13-989-139 No. ULT 2090 5A	**On Standby power**
332	S03	Shared Equipment Lab	EQ-357	Superspeed Refrigerated Centrifuge	1	N/A	O/O	N	F	28"Wx42"Dx51"H	Thermo Scientific	Sorvall Evolution RC - 728211	
332	S03	Shared Equipment Lab	EQ-358	Micro Ultracentrifuge	1	N/A	O/O	N	B	24"Wx30"Dx16"H	Thermo Scientific	Sorvall MTX 150 - 46961	
332	S03	Shared Equipment Lab	EQ-359	Micro Ultracentrifuge	1	N/A	O/O	N	F	18"Wx20"Dx34"H	Thermo Scientific	Sorvall MX Series - 46951	
332	S03	Shared Equipment Lab	EQ-361	Centrifuge	1	N/A	O/O	N	F				
332	S03	Shared Equipment Lab	EQ-385	Elutriating Centrifuge	1	N/A	O/O	N	F	34"Wx28"Dx35"H	Beckman-Coulter	JE6/J26XPI with Avanti J-26XPI	with stobe light assembly & door assembly & viewport
332	S03	Shared Equipment Lab	EQ-386	Image Station	1	N/A	O/O	N	B	25"Wx20"Dx14"H	Carestream Health Inc.	4000 PRO, Cat. # 1046036	with MAC computer
334	C06	Analytical Chemistry R.T. Lab	FH-01	Fume Hood - 6'	1	115313	C/C	N	F	72"Wx36"Dx84"H	Kewaunee	H05_5472B00	Restricted-By-Pass
334	C06	Analytical Chemistry R.T. Lab	FH-02	ADA Fume Hood - 6'	1	115313	C/C	N	F	72"Wx36"Dx84"H	Kewaunee	H08_5472B00	Restricted-By-Pass
335	C11	NMR Lab	EQ-117	300 / 400 MHz Magnet	1	N/A	O/O	E	F		Bruker	Avance 300 / 400	Shielded. **On Standby Power**
335	C11	NMR Lab	EQ-118	Cryo Cooling Unit	1	N/A	O/O	E	F		Bruker		
335	C11	NMR Lab	EQ-119	HPPR	1	N/A	O/O	E	F		Bruker		
335	C11	NMR Lab	EQ-120	He Compressor	1	N/A	O/O	E	F		Bruker		
335	C11	NMR Lab	EQ-121	Buck Booster	1	N/A	O/O	E	F		Bruker		
335	C11	NMR Lab	EQ-122	Avance Console	1	N/A	O/O	E	F		Bruker		
335	C11	NMR Lab	EQ-123	Workstation	1	N/A	O/O	E	F		Bruker		
335	C11	NMR Lab	EQ-124	BCU-05	1	N/A	O/O	E	F		Bruker		
335	C11	NMR Lab	EQ-125	Video Monitor	1	N/A	O/O	E	B				
336		Tank Storage	EQ-373	Cylinder Supports	1	123553	C/C	N	WL				
337	C02a	Organic R.T. Lab	EQ-004	DI Water Polisher	1	115360	C/C	N	IC	13"Wx15"Dx20"H	Millipore	Milli-Q Advantage	with Q-POD
337	C02a	Organic R.T. Lab	EQ-029	Freezer	1	N/A	O/O	E	F	32"Wx31"Dx70"H	Fischer Scientific	13-986-150 Capacity=583L	
337	C02a	Organic R.T. Lab	EQ-042	Glove Box	1	N/A	O/O	N	F	80"Wx32"Dx76"H	Vacuum Atmospheres Company	Nexus VAC 100031	**On Standby power**
337	C02a	Organic R.T. Lab	EQ-044	Glove Box Vacuum Pump	1	N/A	O/O	N	F	20"Wx5"Dx8"H	Leybold Trivac	D4A	
337	C02a	Organic R.T. Lab	EQ-052	Rotovap	1	N/A	O/O	E	B	20"Wx14"Dx19"H	Buchi	R-3000	Inside Fume Hood
337	C02a	Organic R.T. Lab	EQ-053	Rotovap Chiller	1	N/A	O/O	E	B	10"Wx20"Dx24"H	ThermoFisher	Neslab RTE7	Inside Fume Hood.
337	C02a	Organic R.T. Lab	EQ-054	Rotovap Pump	1	N/A	O/O	E	B	5"Wx12"Dx7"H	Gast	5KH33DN16JX	Inside Fume Hood.
337	C02a	Organic R.T. Lab	EQ-062	Balance	1	N/A	O/O	E	B	15"Wx10"Dx14"H	Denver Instruments	P-314	
337	C02a	Organic R.T. Lab	EQ-069	Oven	1	N/A	O/O	E	B	24"Wx26"Dx26"H	Fischer Scientific	625G	

Room Number	Program No.	Space Name	Equip No.	Description	Quantity	Spec. No.	Furnish / Install	New / Exist	Mounted	Size	Manuf.	Model No.	Remarks
337	C02a	Organic R.T. Lab	EQ-077	Vacuum Pump	3	N/A	O/O	E	IC	20"Wx5"Dx8"H	Leybold Trivac	D4A	Inside cabinet under hood.
337	C02a	Organic R.T. Lab	EQ-101	Microwave Reactor	1	N/A	O/O	N	B	15"Wx17"Dx12"H	CEM Corp	925484	Inside Fume Hood.
337	C02a	Organic R.T. Lab	FH-01	Fume Hood - 6'	4	115313	C/C	N	F	72"Wx36"Dx84"H	Kewaunee	H05_5472B00	Restricted-By-Pass
337	C02a	Organic R.T. Lab	FH-02	ADA Fume Hood - 6'	1	115313	C/C	N	F	72"Wx36"Dx84"H	Kewaunee	H08_5472B00	Restricted-By-Pass
338	C05	Analytical Instrument R.T. Lab	EQ-011	Local Exhaust for AA	1	Div 23	C/C	N	C				
338	C05	Analytical Instrument R.T. Lab	EQ-083	LCMS	1	N/A	O/O	E	B	18"Wx29"Dx17"H	Shimadzu	2010-EV	**On Standby power**
338	C05	Analytical Instrument R.T. Lab	EQ-084	LCMS - Prominence UFLC System	1	N/A	O/O	E	B	23"Wx17"Dx26"H	Shimadzu		**On Standby power**
338	C05	Analytical Instrument R.T. Lab	EQ-085	LCMS - System Controller	1	N/A	O/O	E	B		Shimadzu	CBM-20A	Stacked
338	C05	Analytical Instrument R.T. Lab	EQ-086	LCMS - UV-VIS Detector	1	N/A	O/O	E	B		Shimadzu	SPD-20A	Stacked
338	C05	Analytical Instrument R.T. Lab	EQ-087	LCMS - On-Line Degasser	1	N/A	O/O	E	B		Shimadzu	DGU-20A5	Stacked
338	C05	Analytical Instrument R.T. Lab	EQ-088	LCMS - Solvent Delivery Unit	1	N/A	O/O	E	B		Shimadzu	LC-20AB	Stacked
338	C05	Analytical Instrument R.T. Lab	EQ-089	LCMS - Auto Sampler	1	N/A	O/O	E	B		Shimadzu	SIL-20A	Stacked
338	C05	Analytical Instrument R.T. Lab	EQ-090	LCMS - PC & Printer	1	N/A	O/O	E	B				
338	C05	Analytical Instrument R.T. Lab	EQ-091	LCMS - Vacuum Pump	1	N/A	O/O	E	IC				Inside cabinet.
338	C05	Analytical Instrument R.T. Lab	EQ-099	Atomic Absorption Spectrophotometer (AA)	1	N/A	O/O	E	B		PerkinElmer	AAnalyst 800	With PC
338	C05	Analytical Instrument R.T. Lab	EQ-104	GCMS	2	N/A	O/O	N	B	18"Wx29"Dx17"H			**On Standby power**
338	C05	Analytical Instrument R.T. Lab	EQ-105	GCMS -Vacuum Pump	2	N/A	O/O	E	IC				Inside cabinet.
338	C05	Analytical Instrument R.T. Lab	EQ-106	UV-VIS Spectrometer	1	N/A	O/O	N	B				
338	C05	Analytical Instrument R.T. Lab	EQ-107	Luminescence Spectrometer	1	N/A	O/O	N	B				Not Located
338	C05	Analytical Instrument R.T. Lab	EQ-108	FTIR	1	N/A	O/O	E	B				
338	C05	Analytical Instrument R.T. Lab	EQ-110	FTIR	2	N/A	O/O	N	B				
338	C05	Analytical Instrument R.T. Lab	EQ-111	Printer	1	N/A	O/O	E	B				
338	C05	Analytical Instrument R.T. Lab	EQ-113	Microwave Reactor	1	N/A	O/O	E	B	25"Dx20"Wx23"H	CEM Corp	927060	Inside Fume Hood
338	C05	Analytical Instrument R.T. Lab	FH-02	ADA Fume Hood - 6'	1	115313	C/C	N	F	72"Wx36"Dx84"H	Kewaunee	H08_5472B00	Restricted-By-Pass
341	C02b	Organic R.T. Lab	EQ-030	Freezer	1	N/A	O/O	N	F	32"Wx31"Dx70"H			
341	C02b	Organic R.T. Lab	EQ-052	Rotovap	1	N/A	O/O	E	B	20"Wx14"Dx19"H	Buchi	R-3000	Not Located
341	C02b	Organic R.T. Lab	EQ-054	Rotovap Pump	1	N/A	O/O	E	B	5"Wx12"Dx7"H	Gast	5KH33DN16JX	Not Located
341	C02b	Organic R.T. Lab	EQ-060	Solvent Purification System	1	N/A	O/O	N	F	43"Wx29"Dx77"H	Innovative Technology, Inc.	PureSolv MD 5	
341	C02b	Organic R.T. Lab	EQ-061	Vacuum Pump for Solvent Purification System	1	N/A	O/O	N	F	7"Wx13"Dx9"H	Welch	Dryfast Solid PTFE 2044	
341	C02b	Organic R.T. Lab	EQ-069	Oven	1	N/A	O/O	E	B	24"Wx26"Dx26"H	Fischer Scientific	625G	Not Located
341	C02b	Organic R.T. Lab	EQ-082	Vacuum Pump	3	N/A	O/O	N	IC	13"Wx8"Dx8"H	Gast Manuf. Corp.	Standard	Inside cabinet under hood.
341	C02b	Organic R.T. Lab	EQ-375	Explosion Proof Refrigerator	1	N/A	O/O	N	F				
341	C02b	Organic R.T. Lab	EQ-376	Future DI Water Polisher	1	N/A	O/O	N	IC	13"Wx15"Dx20"H	Millipore	Milli-Q Advantage	with Q-POD
341	C02b	Organic R.T. Lab	EQ-405	Rotovap Chiller	1	N/A	O/O	N	B	10"Wx20"Dx24"H	ThermoFisher	Neslab RTE7	Not Located
341	C02b	Organic R.T. Lab	EQ-406	Balance	1	N/A	O/O	N	B	15"Wx10"Dx14"H	Denver Instruments	P-314	Not Located
341	C02b	Organic R.T. Lab	FH-01	Fume Hood - 6'	2	115313	C/C	N	F	72"Wx36"Dx84"H	Kewaunee	H05_5472B00	Restricted-By-Pass

Room Number	Program No.	Space Name	Equip No.	Description	Quantity	Spec. No.	Furnish / Install	New / Exist	Mounted	Size	Manuf.	Model No.	Remarks
341	C02b	Organic R.T. Lab	FH-02	ADA Fume Hood - 6'	1	115313	C/C	N	F	72"Wx36"Dx84"H	Kewaunee	H08_5472B00	Restricted-By-Pass
341	C02b	Organic R.T. Lab	FH-03	Fume Hood - 4'	1	115313	C/C	N	F	48"Wx36"Dx84"H	Kewaunee	H05_5448B00	Restricted-By-Pass
343	C10	Organic Chem Prep Lab	EQ-005	Ice Maker	1	115360	C/C	N	F	36"Wx24"Dx39"H	Hoshizaki	F300BAF	Water Cooled
343	C10	Organic Chem Prep Lab	EQ-070	Oven	1	N/A	O/O	E	B	24"Wx23"Dx26"H	Fischer Scientific	625G	
343	C10	Organic Chem Prep Lab	FH-02	ADA Fume Hood - 6'	1	115313	C/C	N	F	72"Wx36"Dx84"H	Kewaunee	H08_5472B00	Restricted-By-Pass
345	C07	Organic Chem Teaching Lab	EQ-056	Rotovap	2	N/A	O/O	E	B				
345	C07	Organic Chem Teaching Lab	EQ-057	Rotovap -Vacuum Pump	1	N/A	O/O	E	IC				Inside cabinet. Oil Free.
345	C07	Organic Chem Teaching Lab	EQ-063	Balance	4	N/A	O/O	E	B				
345	C07	Organic Chem Teaching Lab	EQ-112	GC	3	N/A	O/O	E	B	12"Wx11"Dx16"H	Gow-Mac		with PC & Printer
345	C07	Organic Chem Teaching Lab	EQ-374	Rotovap -Chiller	1	N/A	O/O	E	IC				Inside cabinet.
345	C07	Organic Chem Teaching Lab	FH-01	Fume Hood - 6'	5	115313	C/C	N	F	72"Wx36"Dx84"H	Kewaunee	H05_5472B00	Restricted-By-Pass
345	C07	Organic Chem Teaching Lab	FH-02	ADA Fume Hood - 6'	1	115313	C/C	N	F	72"Wx36"Dx84"H	Kewaunee	H08_5472B00	Restricted-By-Pass
345	C07	Organic Chem Teaching Lab	FH-03	Fume Hood - 4'	2	115313	C/C	N	F	48"Wx36"Dx84"H	Kewaunee	H05_5448B00	Restricted-By-Pass
	E??	TBD	EQ-202	Meteorology Instrument Suite	1	N/A	O/O	N	F				Locate on Roof. Display in Hallway
	E??	TBD	EQ-203	Meteorology Instrument Server	1	N/A	O/O	N	B				
	E??	TBD	EQ-204	Seismometer Instrument	1	N/A	O/O	N	F				Locate Sensor in Basement. Display in Hallway
	E??	TBD	EQ-205	Seismometer Instrument Server	1	N/A	O/O	N	B				
	P18	Rooftop Astronomy Telescope Storage Room	EQ-329	Dobsonian Telescope	6	N/A	O/O	E	F		Obsession Telescopes	25" Telescopes	

N/A	Not Applicable
N	New Equipment
E	Existing Equipment
B	Bench Top Equipment
F	Floor Mounted Equipment
WL	Wall Mounted Equipment
S	Suspended Equipment
C	Ceiling Mounted Equipment
IC	Inside Cabinet Equipment
L	Length
W	Width
H	Height
O/O	Owner Furnished / Owner Installed
C/C	Contractor Furnished / Contractor Installed
BSC	Biosafety Cabinet
ADA	Americans with Disabilities Act

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. This Section includes, but is not limited to, all materials, labor and equipment, complete with all anchors and related accessory, necessary to furnish, deliver and install:

1. Restricted bypass design chemical fume hoods, Pre-Piped and Pre-Wired, complete with fixtures, supports, lighting fixtures, cup sinks, etc.
2. Restricted bypass design, ADA compliant chemical fume hoods, Pre-Piped and Pre-Wired, complete with fixtures, supports, lighting fixtures, cup sinks, etc.
3. Perchloric fume hoods, Pre-Piped and Pre-Wired, complete with fixtures, supports, lighting fixtures, accessories, etc.
4. Perchloric fume hoods, ADA compliant, Pre-Piped and Pre-Wired, complete with fixtures, supports, lighting fixtures, accessories, etc.
5. Polypropylene fume hoods (Acid) with scrubber, Pre-Piped and Pre-Wired, complete with scrubber, fixtures, supports, lighting fixtures, accessories, etc.
6. Polypropylene vertical laminar flow hoods, Pre-Piped and Pre-Wired, complete with fixtures, supports, lighting fixtures, accessories, etc.

B. Although such work is not specifically shown or specified, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.

C. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 018113, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

D. For general requirements applicable to this and all other Laboratory Equipment Specification Sections including, but not limited to definitions, system description, submittals, LEED requirements, quality assurance, mock-up, testing, field measurements, pre-installation conference, delivery, storage and handling, project conditions, and sequencing requirements, refer to Specification Section 115300 - Laboratory Equipment-General Requirements

E. Products Installed But Not Specified Under This Section:

1. Section 115343 - Laboratory Service Fixtures: Supply of service fixtures for fume hoods for placement under this Section.

1.3 Related Sections:

A. Division 12 Section "Laboratory Casework" for fume hood base cabinets and base stands, including work tops, sinks, and service fittings.

B. Division 22 and 26 Sections for connecting service utilities at back of fume hoods. Piping and

wiring within fume hoods are specified in this Section.

C. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for field quality-control testing of fume hoods.

1.4 REFERENCES

A. Scientific Equipment and Furniture Association, SEFA 1-2010 Laboratory Fume Hoods

B. Scientific Equipment and Furniture Association, SEFA 8-2010 Laboratory Furniture, Casework, Shelving and Tables

C. Scientific Equipment and Furniture Association, SEFA 2-2010 Installation of Scientific Laboratory Furniture and Equipment

D. Underwriters Laboratories, UL 1805 Laboratory Hoods and Cabinets

E. American Society of Heating, Refrigeration and Air-conditioning Engineers, ANSI/ASHRAE 110-1995 Method of Testing Performance of Laboratory Fume Hoods

F. National Fire Protection Association NFPA 45 Flammable and Combustible Liquids Code 2000 Edition

G. National Institute of Health Fume Hood Testing Protocol for Constant Volume Fume Hoods

H. Department of Justice, 28 CFR Part 36 Nondiscrimination on the Basis of Disability by Public Accommodations and in Commercial Facilities

1.5 Fume Hood Test Mock-Up

A. Description:

1. General: Comply with provisions of Division 1.
2. Construct an operating prototype of the type of hood to be supplied for Project and demonstrate its ability to comply with fume hood performance requirements.
3. Test Method: ANSI/ASHRAE Test 110-1995.
4. Perform test under controlled conditions in manufacturer's test facility.
5. Perform engineering and physical modifications on prototype to comply with performance requirements.
6. Manufacturer retains ownership of prototype.
7. Manufacturer bears costs of test mock-up and modifications to achieve performance criteria.
8. Performance requirement: Meet or exceed the recommendations of the American Conference of Governmental Industrial Hygienists as defined in the most recent edition of "Industrial Ventilation. A Manual of Recommended Practice".
9. The fume hood, with vertical rising sash, shall provide adequate containment (meet ASHRAE standard) at set up point of 100 fpm when the sash is set at 18" (normal operating height).

B. Acceptance:

1. Make adjustments necessary to meet minimum performance testing criteria and obtain acceptance from Architect. Do not proceed with shop fabrication or Project installation until mock-up has been tested, and accepted by Architect.

2. Accepted mock-up establishes minimum performance standards and quality for workmanship and materials for Project.

C. Certifications:

1. Submit certification stating that items in this section are installed per applicable referenced codes, standards, specifications and are complete and ready for intended function. Copies of all hood certification test reports shall be included.

1.6 SUBMITTALS

A. Product Data: Submit complete catalogue data, including a chart of manufacturer's standard finishes for all materials, equipment and products for work in this section.

B. Shop Drawings: For laboratory fume hoods. Include plans, elevations, sections, details, and attachments to other work.

1. Indicate details for anchoring fume hoods to permanent building construction including locations of blocking and other supports.
2. Indicate locations and types of service fittings together with associated service supply connection required.
3. Indicate duct connections, electrical connections, and locations of access panels.
4. Include roughing-in information for mechanical, plumbing, and electrical connections.
5. Show relationship to adjoining materials and construction.

C. Test Reports: Submit complete reports verifying conformance to performance standards outlined in this specification when tested to the ASHRAE 110 Standard in the "As Manufactured" environment.

1.7 QUALITY ASSURANCE

A. Source Limitations: Obtain laboratory fume hoods and the laboratory casework below the fume hoods through one source from a single manufacturer.

B. Product Standards: Comply with SEFA 1-2010, Laboratory Fume Hoods, or most current published edition.

C. Product Standard (Construction): All laboratory fume hood shall be Classified by Underwriters Laboratories under UL Standard 1805.

D. Safety Glass: Products complying with testing requirements in 16 CFR 1201 for Category II materials.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

F. Warranty: Manufacturer must offer a minimum three-year warranty on parts and labor to fix defects in materials and workmanship for fume hoods and casework.

1.8 PRODUCT HANDLING

A. Protection: Take necessary precautions to protect the work of this section before, during and after installation.

B. Coordination: Coordinate delivery and installation of laboratory fume hoods with that of the casework, plumbing and electrical work.

C. Project Conditions: Delivery shall take place when site conditions meet the guidelines outlined in SEFA 2-2010 Installation of Scientific Laboratory Furniture and Equipment, or most current published edition.

1.9 EXTRA MATERIALS

A. Furnish complete touch-up kit for each type and color of fume hood finish provided. Include fillers, primers, paints, and other materials necessary to perform permanent repairs to damaged fume hood finish.

1.10 OPERATION AND MAINTENANCE DATA

A. Submit manufacturer's printed, operation and maintenance data.

B. Prior to final acceptance, affix one copy of each manual described in Demonstration Article to an unobscured exterior side panel of each hood.

C. Prior to final acceptance, submit certification that hazardous material cabinet has been electrically grounded as specified.

D. Provide complete written instruction manuals outlining safe operating procedures, safety guidelines, and proper maintenance procedures.

E. Provide a CD-ROM or DVD-ROM with a training presentation, highlighting the proper operating practices of the laboratory fume hood.

PART 2 - PRODUCTS

2.1 GENERAL

A. For general requirements, applicable to this and all other Laboratory Equipment Specification Sections including, but not limited to, manufacturers, materials, components, and finish and performance requirements, refer to Specification Section 115300 - Laboratory Equipment-General Requirements.

2.2 MANUFACTURERS

A. Acceptable Manufacturers:

1. Metal casework, chemical fume hoods, ADA compliant chemical fume hoods, and miscellaneous fillers and panels required for a finished installation:
   a. Jamestown Metal Products, Inc., Jamestown, NY
   b. Kewaunee Scientific Corporation, Statesville, NC
   c. Thermo Scientific Hamilton, Two Rivers, WI

2.3 COMPONENTS

A. Services for Hoods:
Hoods shall be pre-piped and pre-wired at the factory. Plumbing and electrical services shall be as follows:

1. Plumbing services shall consist of front loaded remote control valves as selected located within the end panels, controlled by extension rods projecting through the control panels of the hood, with color coded handles. Interior fitting for gases and water shall be as specified in section 115343. All plumbing fittings shall be factory installed and piped between the valve and the outlet. If fittings are mounted in both ends, there shall be two connection points. Piping shall be routed to the top or bottom of the hood, in coordination with plumbing drawings. Location of plumbing services at ADA hoods shall comply with ADAAG requirements.
2. Pre-Wired hoods shall be wired using flexible metallic conduit to a single junction box located at the top of the hood for a single point connection at the job site. Electrical services shall consist of two duplex receptacles and a light switch. The duplex receptacles shall be 20 Amp, 125 volt AC, and 3-wire polarized grounded. The receptacles shall be of specification grade, ground fault interrupter type, side wired only, to insure a positive connection. The light switch shall be 20 Amp, 125 volt AC, and 3-wire polarized grounded. Location of electrical services at ADA hoods shall comply with ADAAG requirements.

2.4 RESTRICTED BYPASS CHEMICAL FUME HOODS

A. Description:

1. Fume hoods shall be of complete airfoil design to insure maximum operating efficiency. Foil sections at the front fasciae of the hood shall minimize eddying of air currents at the hood face and the rear baffle system shall minimize turbulence in the upper portion of the hood interior.
2. Restricted bypass fume hoods shall be designed for operation on variable air volume (VAV) exhaust systems when used with a fume hood face velocity controller. The air bypass shall be sized to provide an appropriate minimum exhaust volume so that when the sash is closed there will be sufficient exhaust air through the hood to dilute and prevent the escape of contaminants.
3. Frame: A free-standing rigid frame structure of steel angle shall be provided to support exterior panels and interior liner and baffle panels. To allow for maintenance and replacements, the interior liner panels shall be removable without disassembly of the frame structure and outer steel panels. Likewise, the exterior steel panels shall be removable without disassembly of the frame structure and inner liner panels.
4. Walls:
   a. Double wall ends, not more than 5” wide, shall be provided to maximize interior working area. The area between the double wall ends shall be closed to house the remote control valves. The front vertical fascia section shall have a full 135° 1" radius at the front leading edge to provide a streamlined section and insure smooth even flow of air into the hood. The vertical fascias shall contain the required service controls, electrical switches and receptacles. Side posts cannot exceed 4 inches in width. The hood interior end panels and sash track shall be flush with the fascia to prevent eddy currents and back flow of air.
   b. The hood exteriors shall be fabricated of cold rolled steel, phosphate coated with a baked chemical resistant, synthetic resin finish. Rear panel if rear side of hood is exposed to view; shall be finished to match material and color of remainder of hood's outer wall shell.
   c. Interior liner panels shall be 1/4" thick fiberglass reinforced polyester sheet. Interior liner panels shall be fastened using stainless steel screws with plastic covered heads.
   d. Access panels on both inside and outside of hood wall shall be provided. The interior end liner panels shall be furnished with an opening that provides access to the service piping and valves to facilitate installation and maintenance. The openings shall be covered with a removable panel with rounded corners. Panels

which require tools to remove are not acceptable. The panel shall provide an overlapping seal on all edges.

5. Airfoil: A streamlined airfoil shall be installed at the bottom of the hood opening on bench hoods. This foil shall provide a nominal 1" open space between the foil and the top front edge of the worksurface to direct an air stream across the work surface to prevent back flow of air. The airfoil shall extend back under the sash, so that the sash does not close the 1" opening. The foil shall be removable to allow large equipment to be moved into the hood. The foil shall be of 12-gauge steel to resist denting and flexing.
6. Countertop: Construct countertops of 1 inch thick epoxy resin, with dished design to contain spillage with a 6 inch wide safety ledge across the front edge. Where countertops are penetrated by vent piping from fume hood base cabinet, piping shall be located behind the adjustable baffle and sealed tight all around at countertop with waterproof chemical-resistant sealant. A cup drain flush with the recessed worksurface shall be provided. The worksurface and cup sink shall be black. Continuous corrosion-resistant air-tight seam between hood lining and countertop shall be provided.
7. Fume Hood Cup Sinks
   a. Material: Epoxy
   b. Size: 3 by 6 inches nominal
8. Lighting
   a. Two tube T8 fluorescent light fixtures to generate 1075 lx (100 foot candles) of illumination inside hood.
   b. The light fixtures shall be isolated from the hood interior by a 1/4" thick tempered glass panel sealed from the hood cavity.
   c. Fixture shall be UL labeled.
   d. Re-lamping shall be performed from outside of hood front and shall not require removal of hood top-to-ceiling closure panel.
9. Baffles
   a. A baffle with three fixed horizontal slots shall be provided to aid in distributing the flow of air into and through the hood. The baffle shall be spaced out 2-1/4" from the back liner. The baffle shall be removable for cleaning.
   b. Externally adjustable baffle slots, top, and bottom shall be provided. A single point baffle adjustment shall be provided that will allow adjustment of the upper and lower slots. This single baffle adjustment shall allow the operator to make adjustments without placing their hand further than six inches into the hood.
10. Duct Collar
    a. 4 inches high and straight
    b. Outside Diameter: 10 to 12 inches
    c. Fabricated from UNS S31603 stainless steel
    d. Provide stainless steel transition if standard exhaust collar does not meet this requirement
11. Vertical Rising Sash: A vertical rising sash of 1/4" laminated safety float glass shall be provided. The sash shall have a neutral colored polyvinyl chloride horizontal member at the top and a full length metal handle at the bottom. The sash shall be counterbalanced with a single weight to prevent tilting and binding during operation. The sash track shall be a neutral colored polyvinyl chloride set flush with the interior liner panels to minimize turbulence. Bench hoods shall have one sash in a single slotted sash track.
12. Sash height limiting hardware
    a. Provide each fume hood with integral sash height hardware which prevents raising vertical sash above a set point
    b. Set points to be at full closure and 18 inches
13. Distillation Racks:
    a. Hoods shall be furnished with a lattice style distillation racks at locations indicated on lab plans.
    b. The racks shall consist of vertical and horizontal 1/2 “diameter rods. The rods shall be fastened with rod clamps to form a lattice of approximate 12” squares.

c. Bench hood shall have three horizontal rods.

14. Overall depth of hood: 36 inches.
15. Fan Operation Control: Shall be provided under Division 23 - Mechanical.
16. Safety Monitor/Alarm System for Restricted Bypass Fume Hoods: See Division 23.
17. Closure panels:
    a. Provide fume hood closure panels from top of each fume hood to the underside of the finished ceiling.
    b. Match closure panels to fume hood's exterior color and finish.

B. Testing:

1. Independent validation: Written verification of compliance to UL-1805 fume hood standard is mandatory.

2.5 RESTRICTED BYPASS CHEMICAL FUME HOODS - ADA

A. Description:

1. General construction for the ADA compliant Restricted Bypass Chemical Fume Hoods shall be the same as for the Restricted Bypass Chemical Fume Hoods, except as follows:
    a. ADA compliant restricted bypass fume hoods shall be designed to meet guidelines of the Americans with Disabilities Act (ADA).
    b. It shall be complete with Sash Stop, mounted at 21” above the lower deflector to keep the sash from rising above the operators reach.
    c. Fixtures and service fittings shall be moved down to within reach of wheelchair bound operator.
    d. It shall be provided with radiused corner posts and airfoils for smooth air movement to assure high level of comfort, safety and efficiency.
    e. ADA guidelines require a space of 30” wide by 30” high by 25” deep for a wheelchair to roll beneath a fume hood.
2. Testing:
    a. Independent validation: Written verification of compliance to UL-1805 fume hood standard is mandatory.

2.6 PERCHLORIC FUME HOODS

A. Description:

1. Hood interior lining including end panel and back panel, shall be 14 gauge, Type 316 stainless steel with a No. 4 finish. Baffles and top panel shall be 16 gauge, Type 316 stainless steel with a No. 4 finish. The duct collar shall be Type 316 stainless steel with a drip edge. The baffle shall be held in place with stainless steel screws and shall be removable to allow cleaning of the area behind the baffle. The inside back and end panels shall be made in a one-piece wrap around which is welded to the worksurface, forming smooth 1/2” radius corners. All interior corners shall be 1/2” radius, except for top liner, which is spot welded to the wrap-around. The entire stainless steel hood interior shall be reinforced with angles and plug hats to provide a completely rigid assembly and shall be welded together to form a self-supporting assembly. The hood end liners shall not have access openings.
2. Hood service fittings shall include a remote controlled perforated spray pipe to wash down surface of hood in rear of baffle and a remote controlled water fitting. The spray pipe shall run the full length of the hood interior and shall be located above and behind the baffle. Valves for the wash down and water fitting shall be front loaded type, mounted in the vertical fascia panel. The water fitting shall include a panel flange and angle serrated hose connector with a chemical resistant metallic bronze finish

3. Hood light fixture (bulbs not included) shall be the vapor proof incandescent type, 150 watt capacity. Fixture shall be UL approved and labeled.

Hood Size, Ft.	No. of Fixtures
4	1
6	1

4. Hood Worksurface shall be 14 gauge, Type 316 stainless steel with a No. 4 satin finish made in the form of a watertight pan 12” deep to contain spillage, with a 6” wide safety ledge at the front edge and an integral trough sink at the rear. The trough sink shall contain two 1-1/2” I.P.S. outlets located 11” from each outside end panel to facilitate the removal of water from the wash down system.
5. Safety Monitor/Alarm System for Perchloric Fume Hoods, as specified herein.

2.7 PERCHLORIC FUME HOODS - ADA

A. Description:

1. General construction for the ADA compliant Perchloric Fume Hoods shall be the same as for the Perchloric Fume Hoods, except as follows:
   a. ADA compliant perchloric fume hoods shall be designed to meet guidelines of the Americans with Disabilities Act (ADA).
   b. It shall be complete with Sash Stop, mounted at 21” above the lower deflector to keep the sash from rising above the operators reach.
   c. Fixtures and service fittings shall be moved down to within reach of wheelchair bound operator.
   d. It shall be provided with radiused corner posts and airfoils for smooth air movement to assure high level of comfort, safety and efficiency.
   e. ADA guidelines require a space of 30” wide by 30” high by 25” deep for a wheelchair to roll beneath a fume hood.
2. Testing:
   a. Independent validation: Written verification of compliance to UL-1805 fume hood standard is mandatory.

2.8 POLYPROPYLENE FUME HOODS (ACID) WITH SCRUBBER

A. Acceptable Manufacturers:

1. AirClean Systems, Raleigh, NC (Model AIRMAX™ AC4030TE with scrubber)
2. NuAire, Inc., Plymouth, MN
3. TFI/Inline Design Corp., Commerce City, CO
4. ESCO Technologies, Inc., Hatboro, PA
5. Salare, Inc., Henderson, NC

B. Description:

1. Constant Air-Volume Extraction Hood: The constant air volume (CAV) design shall allow the fume hood to achieve a face velocity that complies with current standards. The unit shall exhaust a constant or fixed volume of air and incorporate a sash by-pass system to avoid high velocities when the sash is in the lowered position.
2. The fume hood shall be freestanding, self contained and suitable for relocation if required.
3. Overall Size: 72” Wide x 30” Deep

C. Construction:

1. Internal Chamber: The fume hood internal chamber construction shall be of CP5 FR polypropylene, a fire retardant material rated V-0 per UL-94 testing.
2. Exterior: The exterior construction shall be from molded PVC sections with airfoil sides, top and bottom in the front.
3. Work Surface: The work surface shall be a removable solid-core phenolic laminate that fits inside of the fume hood molded drain base.
4. Drain Base: The drain base construction shall be from CP5 FR polypropylene, the same material as the internal chamber construction. It shall form an integral part of the internal chamber with corner radiuses, an integrated spill lip and a removable solid phenolic laminate work surface.
5. Sash:
   a. The sash shall be ¼" tempered safety glass supported by an aluminum sash frame.
   b. The sash frame shall connect counter-weights located in the front of the unit using a cable and pulley system. The exterior panels shall conceal the sash counter-weight system.
   c. Minimum sash opening shall be approximately two inches.
6. Sash Handle: A full-length shaped handle on the sash shall provide an airfoil entry at the sash opening. There shall be no holes in the glass.
7. Baffle: The installed baffle provides even distribution of fume extraction from the work chamber. The baffle shall be pre-set and non-adjustable. The baffle shall be removable without the use of tools.
8. Light: The fume hood shall include a fluorescent light, mounted externally and sealed from the internal chamber area by a ¼" tempered safety glass panel.
9. Wiring: All wiring within the fume hood shall be enclosed; exposed wiring in accessible locations is not acceptable. All cable terminations shall be enclosed or shrouded including connections to GFCI power outlets and switches.
10. Electrical Outlets: Two electrical duplex outlets shall be provided. Electrical outlets shall be 10amp service, duplex, GFCI outlets installed on the front exterior mullions, outside the work-chamber.
11. Fume Hood Cup Sinks:
    a. Sinks shall be corrosion resistant molded polypropylene.
    b. Size: 3 by 6 inches nominal.
    c. Sinks shall be mounted on the drain base and shall be an integral part of the internal chamber
12. Labels and Data: A permanently fixed label shall be provided on the side of the unit, with the following details:
    a. Manufacturers Name
    b. Serial Number
    c. Model Number
    d. Voltage
    e. Power (Watts)
13. Field Testing:
    a. Field test per Underwriters Laboratories UL 61010A-1 shall be provided.

D. Fume Scrubbing System:

1. The fume scrubber system shall provide complete wet scrubbing of the fume hoods exhaust, generally used with acids and highly soluble chemicals.
2. The fume scrubber construction shall be of PVC and CP5 FR polypropylene materials.
3. The scrubber shall be complete with all sprays, wash pads, drains and mist eliminator.
4. The fume scrubber unit shall include a recirculating wash system comprising of a neutralizing tank, recirculating pump, spill tray, and all associated plumbing necessary to complete the system.
5. The neutralizing tank shall be located below the fume hood in the base cabinets.

6. All components shall be suitable for corrosive environments.

E. Base Cabinets:

1. Base cabinets shall be vented and sized to fit under the fume hood.
2. Base cabinets shall house the scrubber and all of its components and accessories.
3. All contact surfaces shall be constructed of polypropylene.
4. Flame-retardant polypropylene interior.

F. Safety Monitor/Alarm System for Polypropylene Fume Hoods with scrubber, as specified herein.

2.9 POLYPROPYLENE VERTICAL LAMINAR FLOW HOODS

A. Acceptable Manufacturers:

1. NuAire, Inc., Plymouth, MN (Model NU-156 FumeGard)
2. AirClean Systems, Raleigh, NC
3. TFI/Inline Design Corp., Commerce City, CO
4. ESCO Technologies, Inc., Hatboro, PA
5. Salare, Inc., Henderson, NC

B. Description:

1. Fume hoods shall be Vertical Laminar Air Flow for High Acid use. Class 100.
2. Fume Hood Configurations: Provide in sizes and configurations, complete with fume hood bases as shown on the drawings and with all components and accessories necessary for a complete installation.
3. Each fume hood shall have a completely welded shell assembly (case), which shall be rigid and self-supporting, requiring little or no field assembly.

C. Performance Characteristics:

1. All hoods shall be a bench style, single pass flow-through design in which all HEPA filtered work zone (downflow) and work access inflow air, are drawn through the cabinet's internal exhaust plenums to a single exit point at the top.
2. Air shall be drawn into the HEPA filter by the internal supply blower from a pre-filter at the top of the cabinet. The air shall exit the HEPA filter through a diffuser into the work zone in a laminar manner. The air shall split at the removable work surface with ½ being drawn into a rear inlet grill and ½ drawn into the front inlet grill along with the work access inflow. The combination of the downflow and inflow into the front inlet grill shall form an “air barrier” that creates the “personnel protection factor”.
3. The area beneath the removable work surface shall form a leak-tight exhaust plenum that shall drain to a single, polypropylene, 3/8-inch, ball-type drain valve. The drain valve shall be plumbed to a polypropylene “p-trap” where a sink/cup sink has been specified or dead ended into a ball valve. 1½ inch vent holes shall be provided through the bottom of the plenum/cabinet to provide venting for the base cabinets below. One vent hole shall be provided for each base cabinet door and they shall be protected from plenum spills by 3 inch high “mushroom capped” stand pipes.
4. The supply HEPA filter shall be the full cabinets’ work surface width and depth and removable from the front of the cabinet. The work zone shall be the same fixed cross sectional area as the HEPA filter.
5. The positive pressure supply plenum shall be surrounded by negative pressure, even down to the interface of the supply HEPA filter and the filter frame in order to absolutely preclude any gasket leaks from contaminating the HEPA filtered work zone air.
6. The downflow air velocity from a clean HEPA filter shall average from 55 to 65 LFPM with

no single point more than 20% above or below the average velocity measured in a horizontal plane defined by the bottom of edge of the sash at nominal working height (10-inches).

7. Minimum average inflow velocity through the work access opening shall be 105 LFPM with a 10 inch nominal sash opening. Working sash heights shall vary between 8 and 12 inches without a loss of the “personnel protection factor”. The maximum non-working height shall be 20 inches.
8. The exhaust volumes and negative static pressures required per cabinet size shall not exceed the following based on an average inflow velocity of 105 FPM at an work access opening height of 10 inches and an average internal downflow velocity of 65 LFPM.
9. The supply HEPA filter shall be wood board framed and constructed from non-woven pleated fiberglass media with separatorless media. All media shall be a minimum of 99.99% efficient on 0.3-micron particles with greater efficiency on smaller and/or larger particles.
10. The internal downflow blower shall be a non-overloading, backward inclined, dynamically balanced, motorized impeller with the impeller and all hardware (i.e. nuts, bolts, screws, etc) TFE coated by a licensed coating manufacturer, for maximum corrosion resistance. The coating shall be a minimum thickness of 1.5 mil.
11. All motors shall be permanent split capacitor type and sized to automatically compensate for airflow as the filter loads with particulate to achieve a fan delivery fall off of no more than 10% for an 80% increase in pressure drop across the filter. The Class B insulated motor shall be thermally protected, rated for 24- hour continuous operation, lubricated for life and speed controlled by a solid state, voltage regulated solid-state speed controller.
12. Vibration, due to the motor, shall be minimized through the use of vibration isolators when mounting the motor/blower assembly to the internal frame.
13. The work zone shall be illuminated by an externally mounted, polypropylene, fluorescent lamp fixture and shall provide an average of 100 foot-candles, as measured at the work surface. The lamp shall use two T8 bulbs and use a thermally protected, listed electronic ballast with automatic reset. The fluorescent fixture shall be gas-tight and constructed from 1/2-inch polypropylene with a clear Lexan lens. All lamps shall be easily replaceable using simple tools.
14. All electronic controls shall be housed in a separate gas tight polypropylene enclosure and shall be accessible from the top of the cabinet.
15. The polypropylene workspace shall be enclosed on both sidewalls by a 4 inch wide plumbing chase. The chase shall extend the full height and width of the cabinet’s exterior sidewall. Access panels shall be provided on both the exterior and interior sides of the chase. All panels shall mount flush to the surrounding material, be fastened by polypropylene screws and provide sufficient access for maintenance and repair of plumbing, electrical and sash components.

D. Fume Hood Construction:

1. The cabinet workspace, plumbing chase, structural support members and bottom shall be constructed from ½-inch fully stress relieved, refrigerator white, polypropylene sheet stock. All sections are to be reinforced where necessary and continuously heat seam welded to form a rigid structure with all exterior welds finished flush with the surrounding surfaces. All access panels, rear exhaust duct, and the perforated reinforced and removable work surface shall use ¼ inch material.
2. The upper structure of the cabinet containing the HEPA filter, blower, supply plenum and electronics shall use ½ inch thick polypropylene material and shall be an integral extension of the work space sides and back walls (i.e. one-piece construction). Access panels shall be provided at the top of plumbing chase section for maintenance of sash pulleys, counterweight and polypropylene attachment rope.
3. Access to the HEPA filters and motor blower assembly for maintenance and repair shall be through a flush mounted access panel in the upper portion of the hood face. Access to

internal components shall NOT require disassembly of the window sash and glide system.

4. Pre-filters shall be mounted on top of the motor/blower module and easily replaceable. Pre-filters shall be 1 inch thick non-woven fiberglass and shall be 40 percent efficient per the Atmospheric Dust Test.
5. Closure panels, where specified, shall be constructed from materials to match the hood and shall use ¼ inch polypropylene. The panels shall enclose the top of the cabinet to the ceiling and/or the plumbing chase to the wall in the rear. Panels shall be finished to match hood type. For ceiling enclosures, the panels shall be louvered (or slotted) to obtain supply air for the downflow. The side panels shall fasten to the top of cabinet and the rear wall. The front panel shall fasten only to the side panels and easily removable to provide access to the top for maintenance purposes.
6. The glazing material shall be ¼ inch Lexan, unframed. The glazing shall be suspended within polypropylene glide channels by a polypropylene cable routed over front and rear pulleys connected to a totally PVC enclosed counter balanced weight located in the plumbing chase. The counter balance weight shall ride within a close-tolerance outer PVC tube to control vertical motion.
7. The diffuser below the HEPA filter shall fit snugly full width and length of the work zone and constructed from 1/16 inch thick, 22 percent open, perforated PVC and held in place with polypro screws. A vinyl wiper shall be installed between the sash and the interface of the diffuser and the upper workspace to provide a seal against the glazing material. The area above the wiper, but under the sash, shall be maintained under a negative pressure.
8. All internal electrical wiring shall be enclosed in flexible, UL Listed or Recognized, non-metal corrosive-resistant, liquid-tight conduit with listed fittings. All internal junction boxes and enclosures shall be constructed from polypropylene and shall be liquid-tight construction and gasketed where required. All exposed controls and visual indicators shall be constructed from non-metal corrosive-resistant materials or protected by non - metal, gas-tight enclosures with a clear viewing lens, where required.
9. The work surface shall be removable and constructed from ¼ inch thick polypropylene material, reinforced with polypropylene ribbing to maintain surface flatness. The perforated front and rear sections shall be 3/16 inch diameter holes on ¼ inch alternate centers, whose width is suitable to provide both personnel and product protection per the testing methods of NSF STD 49. Where sinks are called out, the work surface shall be segmented such that the sink section is fixed and separate from the rest of the removable work surface.
10. Supply mains to the cabinet shall be connected to a UL Listed junction box of suitable size to accommodate required circuits as indicated on the hood schedule. The junction box shall be non-metallic and require non-metallic liquid-tight connections.
11. Where required, all cabinets shall be provided with a separate support base constructed from ½ inch polypropylene. Fume hood bases shall be constructed per the requirements for polypropylene base cabinets, section 123557, except as specified herein.
    a. Fume hood bases shall have 1½-inch diameter adjustable levelers that are accessible from inside the base cabinet and protected from spills with a ½-inch high rim, covered with a removable cap. A minimum of two (front and rear) levelers shall be provided for each 2-foot section of fume hood. The levelers shall thread through a minimum of 1½-inches of material for stability and permit an adjustment of 2-inches
    b. The top of the base cabinet shall have a 3-inch wide, full interior perimeter stretcher to facilitate assembly to the hood.
    c. Hood bases shall have at least one sealed compartment where sinks/cup sinks are scheduled. The remaining space shall contain a fixed shelf. Where sinks are scheduled on both sides of the workspace, each shall have a sealed compartment. Each sealed compartment shall have an access panel for connection to building utilities. Depending on hood size, any remaining space shall contain a fixed shelf
    d. Each segmented compartment shall be vented to the exhaust duct via a stand

pipe, plumbed through the base of the laminar flow cabinet to the exhaust duct.

e. All base cabinet doors shall have four 1½- inch diameter vent holes, centered 4-inches above the bottom of the door and evenly spaced. An adjustable slide shall be located on the inside of the door, with an identical offset hole-pattern to control airflow through the compartment(s). For compartments with shelves, shelves shall permit air to pass through the front ½-inch of the shelf.

E. Hood Services

1. Services shall be provided in each hood as per the lab drawings. Hood shall not have any pre-punched holes on the hood post except for services indicated on the drawings.
2. Electrical services shall be three wire grounding type receptacles rated for 120 volt. Outlets shall be provided on the hood post where noted. Each outlet shall have a nonmetallic, corrosive resistant, vapor-tight gasketed cover capable of being sealed in place with a gasketed thumbscrew and shall have removable inserts of plastic to seal outlet contacts when not in use. Receptacles shall conform to NEMA standards.

F. Field Testing:

1. Field test per Underwriters Laboratories UL 61010A-1 shall be provided.

2.10 SAFETY MONITOR/ALARM SYSTEM

A. Acceptable Product:

1. The AirSafe™ by AirClean Systems

B. Description:

1. Fume hoods shall be provided with an electronic safety monitor/alarm system to detect low hood face velocities and provide audible and visual alarm if face velocity drops below safe levels. The alarm system shall sense the actual face velocity of the hood regardless of sash position.
2. The system shall have air velocity sensing thermistor located in the monitor on the face of the hood. The monitor shall have a green light activated when the face velocity is above the set point and a red light and audible alarm which are activated when the face velocity is below the set point. The audible alarm shall be acknowledged and silenced with mute switch on panel. When the mute is activated, it shall automatically reset itself when face velocity again rises above calibrated set point.
3. Calibration is the responsibility of the Safety Monitor/Alarm supplier and is required once the hood is stationed and the hood exhaust and room supply systems are balanced. A secondary calibration shall be factory set, at approximately 70 FMP, into the alarm's memory only to determine that the alarm is functional and ready for shipment. The primary calibration must be completed in the field.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. For General Installation Requirements, applicable to this and all Laboratory Equipment Specification Sections including, but not limited to, examination, installation, adjusting, cleaning, and protection general requirements, refer to Specification Section 115300 - Laboratory Equipment - General Requirements.

3.2 FIELD QUALITY CONTROL

A. Field test installed fume hoods according to ASHRAE 110 to verify compliance with performance requirements.

1. Adjust fume hoods, hood exhaust fans, and building's HVAC system, or replace hoods and make other corrections until tested hoods perform as specified.
2. After making corrections, retest fume hoods that failed to perform as specified.

B. Field test shall be performed by a qualified independent third party contractor, not the fume hood manufacturer or a representative or affiliate of the manufacturer.

3.3 ADDITIONAL INSTALLATION REQUIREMENTS

A. Fasten together assemblies to meet Performance Requirements specified above.

B. General: Install fume hoods level, plumb, and true; shim as required, using concealed shims, and securely anchor to building and adjacent laboratory casework. Securely attach access panels, but provide for easy removal and secure reattachment. Where fume hoods abut other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical.

C. Comply with requirements in Section 115353 - Laboratory Casework-General Requirements for installing fume hood base cabinets, work tops, and sinks.

D. Comply with requirements in Divisions 22 and 26 Sections for installing water and laboratory gas service fittings and electrical devices.

1. Install fittings according to Shop Drawings, installation requirements in SEFA 2, and manufacturer's written instructions. Set bases and flanges of sink and work top-mounted fittings in sealant recommended by manufacturer of sink or work top material. Securely anchor fittings to fume hoods unless otherwise indicated.

E. Field Joints:

1. Reinforce and weld in manner equivalent to shop welds and joints.

F. Wall Joints:

1. Joints between equipment and walls up to 3/8 inches wide:
   a. Fill with sealant backing bond breaker rod and silicone sealant.
   b. Comply with requirements of Division 7.
   c. Apply sealant in one continuous pass, compressing surface slightly concave and forcing contact with both sides of joints.

2. Joints between fume hoods and walls larger than 3/8 inches wide:
   a. Seal with stainless steel closure or filler strip.
   b. Fit tightly and fasten securely with concealed clips.

G. Site Tolerances: Install wall-to-wall countertops with a maximum 1/4 inch gap.

3.4 ADJUSTING

A. Repair or remove and replace defective work, as directed by the Owner's Representative upon

completion of installation.

B. Adjust sash, fixtures, accessories and other moving or operating parts to function smoothly.

3.5 CLEANING

A. Clean equipment, touch up as required.

3.6 PROTECTION OF FINISHED WORK

A. Provide all necessary protective measures to prevent damage to equipment from exposure to other construction activity.

B. Advise Contractor of procedures and precautions for protection of material and installed fume hoods from damage by work of other trades.

3.7 TRAINING

A. Upon completion of the installation of the fume hoods, Manufacturer must conduct a training seminar for the Owner's users at the job site discussing proper operation of the fume hood, fume hood features and best use practices. Training session must be at least 30 minutes in length, not including a question and answer session. Training session must be scheduled within 30 days on completion of the installation.

END OF SECTION 115313

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: This Section includes, but is not limited to, all materials, labor and equipment, complete with all anchors and related accessories, necessary to furnish, deliver and install:

1. Autoclave
2. Under-counter Glass Washer
3. Glass Washer / Dryer

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 018113, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. For general requirements applicable to this and all other Laboratory Equipment Specification Sections including, but not limited to definitions, system description, submittals, LEED requirements, quality assurance, mock-up, testing, field measurements, pre-installation conference, delivery, storage and handling, project conditions, and sequencing requirements, refer to Specification Section 115300 - Laboratory Equipment-General Requirements.

PART 2 - PRODUCTS

2.1 GENERAL

A. For general requirements applicable to this and all other Laboratory Equipment Specification Sections including, but not limited to, manufacturers, materials, components, and finish and performance requirements, refer to Specification Section 115300 - Laboratory Equipment-General Requirements.

2.2 AUTOCLAVE

A. Acceptable Manufacturers & Products:

1. Getinge International, Lakewood, NJ (Model # GE-633LS)
2. Steris Corporation, Mentor, OH
3. Beta Star, Telford, PA

B. Description:

1. Polished stainless steel medium steam, cabinet enclosed sterilizer with integral steam generator.
2. Type: Microcomputer controlled automatic steam sterilizer with operator selectable cycles for laboratory, scientific or general-purpose gravity or vacuum steam sterilization and decontamination of laboratory research supplies.

3. Interior Chamber Size: 26” L x 26” H x 39” D
4. The sterilizer shall be designed for free-standing installation. Stainless steel side panels shall enclose the sterilizer body and piping.
5. Each unit shall be provided with vacuum and gravity cycles for the sterilization of liquids, porous loads, and hard goods.
6. Sterilizer shall be equipped with prevacuum, gravity, liquid, leak test and daily air removal test cycles.
7. Sterilizer shall be designed so that the service access panel is located on the left side of the unit where maintenance and service can be performed on sterilizer components.
8. Chamber construction: The chamber shall be constructed of an inner shell and a series of “U” channels that form the outer jacket of the chamber. The gasket ring and backhead shall be formed and welded to the chamber body. Chamber material and door material are 316 stainless steel. The”U” channel material shall also be 316 stainless steel. Internal surfaces shall be high polished to facilitate cleaning. All pressure vessel construction meets ASME code requirements for pressures up to 45 psig and full vacuum. The gasket ring holds a continuous, one-piece silicone gasket, 0.63” in diameter, which shall be replaceable. A steam baffle shall be provided to prevent condensation from wetting the load. An extra threaded opening shall permit passage of thermocouple leads to monitor interior and load temperatures. The steam connections to the “U” channels and to the chamber are 316 stainless steel. The internal corners shall be radiused to aid cleaning and the chamber floor shall slope to a central drain. A stainless steel mesh strainer shall protect the drain port from blockage by debris. The sterilizer chamber shall be completed insulated with minimum 2" chloride free mineral wool. The chamber shall be mounted on a stainless steel framework with adjustable feet.
9. Door: Provide fully automatic vertical sliding single door. Door operation shall be controlled via push buttons on the control panel. A mechanical safety shall stop the door if it is obstructed while closing. The door shall be automatically sealed at the start of a cycle. A mechanical locking bar shall provide added safety when the door is fully closed. A pressure switch shall monitor the gasket pressure throughout the process and shall initiate an alarm in the event of loss of pressure. Steam may not enter the chamber unless this switch is actuated. At the end of the process, the seal shall be withdrawn by vacuum and the door shall be opened for unloading.
10. Personnel safety features: In addition to the door safety systems, the chamber shall be provided with a pressure monitor that ensures that all chamber pressure has been relieved prior to allowing the door to open. As an "intrinsic safety" feature, when the door seal is retracted the chamber shall be completely vented to atmosphere while the door is still retained in the fully closed and mechanically locked position. The fascia temperature shall be <45ºC.
11. Mechanical vacuum pump. A single stage liquid ring vacuum pump, mounted on vibration isolators for quiet operation shall be provided to effectively remove air from within the chamber.
12. Drain cooling. The drain discharge shall be indirectly cooled down to reduce the effluent temperature to 140ºF (60ºC) or less.
13. Pressure gauges for chamber pressure and jacket pressure shall be mounted in visible location.
14. Steam Source: 30kW integral steam generator with an automatic feed water pump shall be provided.

    a. Steam Supply: Unit shall be provided with an integral electrically heated steam generator. The generator shall be 30kW, and shall be mounted under the sterilizer chamber. The generator pressure vessel shall be made of 316Ti stainless steel, insulated with 50 mm chloride free mineral wool enclosed in a rigid removable aluminum sheet metal housing. A water level glass for inspection of the pressure vessel shall be visible from the service area. The unit shall comply with the ASME code for un-fired pressure vessels. Vendor to provide appropriate steam pressure reducing valve. The steam generator shall come equipped with an ASME blowdown separator with automatic blowdown and programmable seven day timer.

15. Temperature and pressure sensors. Each sensor shall be factory calibrated with individual constants. The pressure sensor shall be equipped with software base temperature compensation. The following sensors shall be provided and shall be used in the automatic control of the sterilizer:
16. Control system features: The control system shall be designed to control the processing equipment, and shall control all system functions and shall monitor the operation of the sterilizer. The system shall document operations and shall provide visual indication of all operating parameters. Operating status shall be provided both visually and audibly to alert operators of cycle completion or alarm conditions.
17. Controls: Front mounted controls.
18. Water Saver Package: Sterilizer shall be provided with Water Saver Package. The system shall be adjusted properly and shall provide water savings of 75% or greater.
19. 208/240 VAC, 60 Hz, 3-Phase, 125 A
20. The following components, options and accessories shall also be provided.
    a. Automatic Steam Boiler Blow-down
    b. Backflow preventer
    c. Loading Car, with interior track
21. Meet UL and CSA codes, ASME approved.

2.3 UNDER-COUNTER GLASSWASHER

A. Acceptable Manufacturers & Products:

1. Labconco, Kansas City, MO (Flask Scrubber Model No. 44203-30)
2. Scientek, Richmond, B.C., Canada
3. Hotpack, Warminster, PA

B. Description:

1. Under Counter Flask Scrubber Glassware Washer for 115 volt operation with viewing window.
2. The Washer shall be a cabinet-type washer with completely automatic solid-state circuitry that monitors and controls all cycle phases.
3. The enclosed washer shall be mounted under a counter.
4. Washer shall meet the Underwriters Laboratories (UL) Standard 544 as certified by ETL Testing Laboratories, Inc.
5. Chamber load capacity: 22-1/2” W x 21” D x 18” H
6. Exterior dimensions: 24” W x 26” D x 34-1/2” H
7. Heaters: A 750 watt sump heater and 700 watt steam heater to boost water and glassware temperatures during washing and drying shall be provided. Minimum inlet temperature of 120° F (49° C). The sump heater shall elevate water temperature approximately 20° F (11° C).
8. View Window and Light: Clear tempered safety glass window, 6" W x 13" H, shall be located in the door. A 25-Watt interior light shall remain lit while the door latch is engaged.
9. It shall include ultra-pure water final rinse provided by the building’s central RO/DI system.
10. Drain cooling: The drain discharge shall be indirectly cooled down to reduce the effluent temperature to 140° F or less.
11. Provide plumbing components, solenoid valve and electrical connections necessary to mix cold tap water with hot drain water so that water (<60° C (<140° F)) is directed to the house drain system. When the washer’s drainage pump is activated, the solenoid valve opens releasing the flow of cold tap water to the drain.

C. Construction:

1. Tank, wash arms, tower and side rails shall be constructed of Type 304 stainless steel with mirror finish. Tank shall have two rows of polypropylene rollers. Tower shall telescope and lock in two positions. Fiberglass blanket and aluminum-backed acoustic material shall provide thermal and sound insulation. A draw latch shall energize the electronic controls when locked.

D. Control Panel:

1. Injection molded panel shall have microprocessor that stores five factory preset programs (RINSE ONLY, PLASTIC, GLASS, GLASS PLUS AND SCIENTIFIC) and two user set programs (USER 1 SET and USER 2 SET).

E. Racks and Inserts:

1. Shall be constructed of Type 304 stainless steel.
2. The following Racks, Inserts and Accessories shall be provided:
   a. Adjustable Height Top Rack
   b. Bottom Rack
   c. Utensil Basket

2.4 GLASS WASHER / DRYER

A. Acceptable Manufacturers and Products:

1. Lancer, Winter Springs, FL (LABEXIA - Model 1700 LXA)
2. Steris Corp., Menton, OH (AMSCO – Reliance Glassware Washer – Model 500).
3. Getinge International, Lakewood, NJ.

B. Description:

1. The Laboratory Glassware Washer shall be a cabinet-type.
2. Chamber Load Capacity: 39"W x 25 ½"H x 26"D.
3. Overall Dimensions: 56"W x 80"H x 31”D.
4. The washer shall be pre-programmed with three adjustable cycles: light, medium, and heavy. All three factory set cycles shall be able to be modified by the operator to include the following treatments:
5. PREWASH - Load shall be sprayed with recirculated water at the selected temperature, for a selected amount of time (0-15 minutes). On completion of the treatment, water shall be sent to the drain.
6. WASH - Load shall be sprayed with recirculated solution at the selected temperature, for the selected amount of time (0-15 minutes). On completion of the treatment, water shall be sent to the drain.
7. RINSE - Load shall be sprayed with recirculated water at the selected temperature, for the selected amount of time (0-15 minutes). On completion of the treatment, water shall be sent to the drain.
8. PURE WATER RINSE - Load shall either be sprayed with recirculated water at the selected temperature or sprayed with non-recirculated pure water (supplied from the storage tank) for 10 seconds. If heated water is selected, treatment shall not start until the selected temperature is reached. On completion of treatment, water shall either be sent to the drain, or retained for use in the first treatment of the next cycle.
9. Washer shall be provided with Drying System. Drying System shall be programmed to occur after the final rinse treatment of a cycle. During drying treatment, chamber air shall be heated to the selected temperature (up to 240 degree F (116 deg. C) and recirculated through the chamber and accessory headers, while a portion shall be exhausted to vent. System shall include a 1.5 HP blower and electric heaters.

10. Stainless Steel Construction.
11. Vertical sliding door shall be constructed of tinted, tempered glass with stainless steel trim, to allow the operator to view the chamber with the doors closed. While the cycle is in progress, glass shall remain cool to the touch. Sliding doors shall be configured for manual operation.
12. A 75-watt interior light, mounted within an explosion/vapor proof enclosure shall illuminate the wash chamber.
13. Washer shall meet the Underwriters Laboratories (UL) Standard 544 as certified by ETL Testing Laboratories, Inc. It shall be ASME approved.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. For General Installation Requirements applicable to this and all other Laboratory Equipment Specification Sections including, but not limited to, examination, installation, adjusting, cleaning, and protection requirements, refer to Specification Section 115300 - Laboratory Equipment-General Requirements.

END OF SECTION 115319

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. This Section includes, but is not limited to, all materials, labor and equipment, complete with all anchors and related accessories, necessary to furnish, deliver and install:

1. Domestic Hot and Cold Water Fixtures
2. Ultra-Pure Water Fixtures
3. Laboratory Gas Fixtures
4. Electrical Service Fixtures
5. Fume Hood Service Fixtures
6. Barrier-Free Eye Wash Station
7. Barrier-Free Emergency Shower/Eye Wash Station
8. Barrier-Free Non-Metal Safety Station

B. Although such work is not specifically shown or specified, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.

C. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 018113, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

D. For general requirements applicable to this and all other Laboratory Equipment Specification Sections including, but not limited to definitions, system description, submittals, LEED requirements, quality assurance, mock-up, testing, field measurements, pre-installation conference, delivery, storage and handling, project conditions, and sequencing requirements, refer to Specification Section 123553 - Laboratory Casework-General Requirements.

E. Products Specified But Not Installed Under This Section:

1. Section 115313 - Fume Hoods: Factory installation of laboratory service fixtures in fume hoods.

F. Related Sections:

1. Section 123553 - Laboratory Casework - General Requirements.
2. Section 123554 - Metal Laboratory Casework: Fixture mounting holes.
3. Section 123555 - Wood Laboratory Casework: Fixture mounting holes.
4. Division 22 - Plumbing: Connection of laboratory service fixtures to service lines.
5. Division 26 - Electrical: Connection of laboratory service fixtures to service lines.

1.3 CERTIFICATIONS

A. Provide certification for each item, that the products provided have been evaluated by the National Recognized Testing Laboratory (NRTL) to the applicable ANSI/UL and CSA Standards, for use in the US.

PART 2 - PRODUCTS

2.1 GENERAL

A. For general requirements applicable to this and all other Casework Specification Sections including, but not limited to, manufacturers, materials, components, and finish and performance requirements, refer to Specification Section 123553 - LABORATORY CASEWORK-GENERAL REQUIREMENTS.

B. Manufactured Units:

1. Plumbing Fixtures:

a. Heavy duty special design manufactured for laboratory use.
b. Provide with mounting shank of length and type suitable for substrate condition, lock nut, and other mounting devices necessary for attachment to countertops, backsplashes, and panels.
c. Factory assemble fixtures with valves and mounting shanks.
d. Individually factory pressure-tested.
e. Fixture shipment: Provide fixtures loose, except for factory-mounted fixtures in fume hoods specified in Section 115313.
f. Fabricate to accommodate index coding. Color code services as follows:
1) Fitting handles: Color-coded plastic hooded handles with index buttons mounted in handle
2) Identify services with lettered and color-coded buttons:

Laboratory hot water:	HW	Red
Laboratory cold water:	CW	Dark Green
Laboratory compressed air:	CA	Orange
Laboratory vacuum:	VAC	Yellow
Reverse Osmosis/Deionized Water	DI	White
Nitrogen	N	Brown
Oxygen	OXY	Light Green
Helium	HE	Black
Argon	AR	Violet
Carbon Dioxide	CO2	Pink
Acetylene	ACET	Violet
Ethylene	ETH	Black
Special Gas (N2O2)	SG	Gray
Special Gas (P-10)	SG	Light Blue
Special Gas (N2H)	SG	Light Blue
Chilled Water Supply	CHWS	Dark Green
Chilled Water Return	CHWR	Red

C. Provide natural polypropylene laboratory faucets and service fixtures at laboratories requiring polypropylene casework and at polypropylene fume hoods.

2.2 HOT AND COLD WATER FIXTURES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Water Saver Faucet Company, Chicago, IL
      a. Deck Mounted Hot and Cold Water Mixing Faucet with 8” swing type gooseneck with vacuum breaker - Model No. L412-8VB.
      b. Deck Mounted Cold Water Faucet with 8” swing type gooseneck with vacuum breaker - Model No. L612-8VB.
      c. Deck Mounted Hot and Cold Water Mixing Faucet with 8” swing type gooseneck with vacuum breaker & wrist blade handles for ADA sinks - Model No. L412-8VB-BH.
      d. Deck Mounted Cold Water Faucet with 8” swing type gooseneck with vacuum breaker & wrist blade handle for ADA sinks - Model No. L612-8VB-BH.
      e. Wall Mounted Single Outlet Cold Water Valve with in-line vacuum breaker and serrated hose end - Model No. L2800-110.
      f. Wall Mounted Single Outlet Processed Chilled Water Supply and Return Valve - Model No. L4301.
      g. See Article 2.5 for Quick Connect Assemblies for ADA workstation
   2. Chicago Faucets, Des Plaines, IL
   3. Kewaunee Scientific Corporation, Statesville, NC

B. Description:

   1. Design for maximum operating water pressure 80 psi.
   2. Made of chrome-plated brass with an 8" spread swing gooseneck.
   3. Removable straight serrated hose connector.
   4. Provide with integral vacuum breaker on goosenecks to prevent backflow. Vacuum breakers shall be designed specifically for laboratory applications. As such, they shall be design to seal properly and prevent spillage under extreme low flow conditions.
   5. Valves shall be disc type with renewable internal assemblies.
   6. Handles:
      a. Forged brass four-arm handle for ease of griping and turning. Furnished with full view color-coded index disc secured with cement.
      b. Provide Wrist Blade Handles at ADA sinks.
   7. Individually factory test prior to shipment.
   8. Place water fitting at cup sinks parallel to the work surface.
   9. All faucets shall meet the requirements of ANSI/ASME A112.18.1M.
   10. Vacuum breakers shall be certified by the American Society of Sanitary Engineers (ASSE) under ASSE Standard No. 1001.

2.3 ULTRA PURE WATER FIXTURES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   1. Water Saver Faucet Company, Chicago, IL (Model # L7833)
   2. Chicago Faucets, Des Plaines, IL
   3. Orion Fittings, Kansas City, KS

B. Description:

   1. Faucets and valves for distilled, deionized and pure water service shall be fabricated with a brass exterior and an interior lining of inert polypropylene. All components in contact

with pure water shall be polypropylene. Valves shall be self-closing type, and shall have a round molded nylon handle, screw-on index disc and a removable serrated hose end. Valves shall have a brass valve body, brass bonnet and brass stem with a floating tip.

2. Deck mounted fixture.
3. Maximum working pressure 50 psi.
4. Fixture inlet for 3/8" O.D. polypropylene tubing.

2.4 LABORATORY GAS FIXTURES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Water Saver Faucet Company, Chicago, IL
   Deck-Mounted Fixtures with removable serrated hose ends
   - Single Outlet Turret — Model No. L4200FH-131WS
   - Two-way 180° Outlet Turret — Model No. L4200FH-132SWS

   Wall/Panel Mounted Fixtures
   - Single Outlet Turret — Model No. L4200FH-158WS
   - Single Outlet w/quick disconnect — Model No. L4203FH
2. Chicago Faucets, Des Plaines, IL
3. Fisher Hamilton, Two Rivers, WI

B. Description:

1. Laboratory Ball Valves:
   a. On/off control of gas, air or vacuum at pressures up to 75 psi.
   b. Valve Body: Forged brass with polished chrome plated finish.
   c. Valve Unit: Quarter-turn open/close with chrome plated brass ball and molded TFE seals.
   d. Handle: Lever handle chrome-plated forged brass.
2. Hose end:
   a. Removable, serrated, non-slip.
   b. Straight, unless otherwise indicated.
   c. Quick disconnect at designated accessible workstation locations.
3. Provide with cylindrical turret with single or double outlets, as shown on drawings.
4. Provide fine control needle valves for nitrogen, helium and other special gas services at pressures over 75 psi.
5. Fixture shall be fully assembled and factory tested prior to shipment.

2.5 ELECTRICAL SERVICE FIXTURES

A. All electrical outlets to be provided under Section 260002 - ELECTRICAL WORK and Section 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS, unless noted otherwise.

B. Electrical Pedestals: Provide electrical pedestals with enclosure boxes, receptacles, and stainless steel cover plates:
   1. Provide deck mounted, single faced, single wide, wrinkled black, epoxy powder coated box with ¾" IPS tank nipple (Kewaunee model # W-0581-2V).
   2. Provide deck mounted, double faced, single wide, wrinkled black, epoxy powder coated box with ¾" IPS tank nipple (Kewaunee model # W-0581-3V).
   3. Provide deck mounted, double faced, double wide, wrinkled black, epoxy powder coated box with 1" IPS tank nipple (Kewaunee model # W-0581-8V).

C. Provide Ground Fault Interrupter Receptacles where required.

2.6 FUME HOOD SERVICE FIXTURES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Kewaunee Scientific Corporation, Statesville, NC
   (Model numbers indicated below are by Kewaunee unless noted otherwise)
   - Remote Control Cold Water Fixture — Model No. W-0740-L/R-CW-I-X
   - Remote Control Processed Chilled Water Fixtures
     - Chilled Water Supply — Model No. W-0739-L/R-CWS with insulation
     - Chilled Water Return — Model No. W-0739-L/R-CWR with insulation
   - Remote Control Ultra Pure Water (Polypropylene)
     - Outlet with swing type 90° deg gooseneck/serrated end — Model No. L7739W
   - Remote Control Laboratory Gas Fixtures
     - Air — Model No. W-0739-L/R-AIR-I
     - Vacuum — Model No. W-0739-L/R-VAC-I
     - Nitrogen — Model No. W-0739-L/R-NIT-I
     - Oxygen — Model No. W-0739-L/R-OXY-I
   - Electrical Fixtures for mounting in Fume Hoods
     - Single Duplex Receptacle, 120V AC, 20A — Model No. 0581-1V-I
     - Toggle Switch, single pole, 120/240V AC, 20A — Model No. 0655-1V-I
     - Combination Toggle Switch/Receptacle, 120/240V, 20A — Model No. 0593-1V-I
2. Chicago Faucets, Des Plaines, IL
3. Water Saver Faucet Company, Chicago, IL

B. Description:

1. Panel mounted valve for installation on angle face of hood. Valve shall be installed from behind panel and shall be secured with external locking ring on front of hood.
2. Valves shall be installed on the front exterior face of the hood. Fixtures shall be front loaded without extension rods between the valve and handle. Valves shall be accessible from the front exterior face of the hood for maintenance.

C. Finish:

1. Polished Chrome with Clear Epoxy. Clear epoxy coating applied over a polished chrome plated surface. Finish has a bright chrome appearance with enhanced chemical resistance.
2. Fittings inside fume hoods shall have an epoxy finish color-coded to match the fixture service index color. Coating material shall be free flowing epoxy powder with a particle size of 35-70 microns. Surfaces to be coated shall be (a) polished or sandblasted to produce a uniform fine-grained surface and (b) immersed in a phosphoric acid cleaning solution to remove thoroughly all oil, grease and other foreign substances. Following cleaning, coating material shall be electrostatically applied to all exposed surfaces. After application, coating shall be fully baked to permit curing. Surfaces shall have a minimum coating thickness of 2 mils.

D. Remote Control Cold Water Fixtures:

1. Valves for water service.
2. Front loaded fittings including brass valve with renewable stainless steel seat and neoprene valve disc, nylon color coded panel flange with angle serrated hose connector
3. Color coded nylon 4-arm handle.
4. Gooseneck in fume hood shall be cast bronze with a white powder coated epoxy finish.
5. Fume Hoods shall be pre-piped as specified in Section 115313.

E. Remote Control Supply and Return for Process Chilled Water (PCW):

1. Valves for process chilled water supply and return (CHWS and CHWR).
2. Front loaded fittings including brass valve with renewable stainless steel seat and neoprene valve disc, nylon color coded panel flange with angle serrated hose connector.
3. Color coded nylon 4-arm handle.
4. Fume Hoods shall be pre-piped as specified in Section 115313.

F. Remote Control Laboratory Gas Fixtures:

1. Needle valves for standard control of gas or vacuum at pressures up to 150 psi.
2. Push/turn construction with pup-up indicator buttons.
3. Front loaded fittings including brass valve with replaceable stainless steel seats, nylon color coded panel flange.
4. Color coded nylon 4-arm handle.
5. Outlet in hood shall include panel mounted flange with angle serrated hose end and mounting shank.
6. Fume Hoods shall be pre-piped as specified in Section 115313.

G. Electrical Fixtures:

1. Include receptacles, switches and faceplates
2. Face plates shall be Type 302 stainless steel with formed and beveled edges
3. Quantity and location as indicated on drawings
4. Fume Hoods shall be pre-wired as specified in Section 115313.

2.7 BARRIER-FREE EYE WASH STATION (EW)

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Water Saver Faucet Company, Chicago, IL
(Barrier Free Recessed Eye Wash Station with Drain Pan - Model No. FEBF735DP)
2. Guardian Equipment, Chicago, IL
3. Chicago Faucets, Des Plaines, IL

B. Description:

1. Recessed mounted, barrier-free swing-down eye/face wash station with drain pan.

C. Construction:

1. Eye/face wash shall have stainless steel cover. Opening cover shall pull outlet head assembly down from vertical to horizontal position and activate water flow. Horizontal grab bar shall be easily grasped and pulled in an emergency. While unit is in operation, wastewater shall be collected by drain pan and returned into unit for drainage. Unit shall remain in operation until cover is returned to closed position.
2. Provide with two fine spray outlet heads mounted on supply arms. Each spray head shall have internal flow control and filter to remove impurities from water.
3. Unit shall be installed so that spray heads are no more than 36” above finished floor.
4. Eye/Face Wash Valve: 1/2” IPS brass stay-open ball valve. Mounting: Entire unit shall be enclosed in an 18 gauge stainless steel cabinet with flanged rim for recessed mounting in

wall. Combination cover and drain pan shall be 18 gauge stainless steel. Unit shall fit in standard 3 5/8" deep wall.

5. All pipe and fittings shall be stainless steel or brass.
6. Design for maximum operating water pressure of 80 psi.
7. Individually factory test prior to shipment.
8. Furnish with ANSI-compliant identification sign
9. Comply with the requirements of ANSI Z358.1 for eyewash and emergency shower equipment.

2.8 BARRIER-FREE EMERGENCY SHOWER/EYE WASH STATION (ES/EW)

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Water Saver Faucet Company, Chicago, IL
(Barrier Free Recessed Safety Station with Drain Pan - Model No. SSBF2150)
2. Guardian Equipment, Chicago, IL
3. Chicago Faucets, Des Plaines, IL

B. Description:

1. Recessed barrier-free eye/face wash and shower safety station with ceiling mounted exposed shower head and drain pan.

C. Construction:

1. Shower Head: 10" diameter stainless steel. Spray pattern shall be 20 inches diameter at 60 inches above floor.
2. Furnished with stainless steel vertical supply pipe and ceiling escutcheon for mounting shower head at desired height below finished ceiling.
3. Shower Valve: 1 inch IPS brass stay-open ball valve with stainless steel "panic bar". Pulling bar down activates shower; shower remains in operation until bar is returned to original closed position. Furnished with stainless steel access panel and 1" IPS unions for valve.
4. Eye/face wash section of unit shall have stainless steel cover. Opening cover shall pull outlet head assembly down from vertical to horizontal position and activate water flow. Horizontal grab bar shall be easily grasped and pulled in an emergency. While unit is in operation, wastewater shall be collected by drain pan and returned into unit for drainage. Unit shall remain in operation until cover is returned to closed position.
5. Provide with two fine spray outlet heads mounted on supply arms. Each spray head shall have internal flow control and filter to remove impurities from water.
6. Unit shall be installed so that spray heads are no more than 36" above finished floor.
7. Eye/Face Wash Valve: 1/2" IPS brass stay-open ball valve. Mounting: Entire unit shall be enclosed in an 18 gauge stainless steel cabinet with flanged rim for recessed mounting in wall. Combination cover and drain pan shall be 18 gauge stainless steel. Unit shall fit in standard 3 5/8" deep wall.
8. All pipe and fittings shall be stainless steel or brass.
9. Design for maximum operating water pressure of 80 psi.
10. Individually factory test prior to shipment.
11. Furnish with ANSI-compliant identification sign
12. Comply with the requirements of ANSI Z358.1 for eyewash and emergency shower equipment.

2.9 BARRIER-FREE NON-METAL SAFETY STATION (Non-Metal ES/EW)

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Haws Corporation, Sparks, NV
(Barrier Free Non-Metal Safety Station with Drain Pan - Model No. 8336)
2. Guardian Equipment, Chicago, IL
3. Bradley Corporation, Menomonee Falls, WI

B. Description:

1. Corrosion-resistant, PVC plastic combination shower and eye/face wash with eye/face wash and showerhead, and green epoxy coating

C. Construction:

1. Entire unit is pre-built and fully water and pressure tested to ensure no leaks and proper function.
2. Unit shall include plastic 11” inch diameter showerhead with integral floe control.
3. Unit shall include plastic 11” inch diameter round bowl, shower and eyewash ball valves equipped with ball and stem, with green epoxy finish.
4. Schedule 80 PVC plastic floor flange and vertical support pipe.
5. Provide with two fine spray outlet heads mounted on supply arms. Each spray head shall have internal flow control and filter to remove impurities from water. Provide plastic protection covers to spray heads.
6. Unit shall be installed so that spray heads are no more than 36” above finished floor.
7. All pipe and fittings shall be of 2 ½” green epoxy finished schedule 80 PVC.
8. Design for maximum operating water pressure of 80 psi.
9. Individually factory test prior to shipment.
10. Furnish with ANSI-compliant identification sign
11. Comply with the requirements of ANSI Z358.1 for eyewash and emergency shower equipment.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. For General Installation Requirements, applicable to this and all other Casework Specification Sections including, but not limited to, examination, installation, adjusting, cleaning, and protection general requirements, refer to Specification Section 123553 - Laboratory Casework-General Requirements.

3.2 ADDITIONAL INSTALLATION REQUIREMENTS

A. Install in accordance with specifications.

B. Install items plumb, level and square.

C. Maintain dimensional tolerances and alignment with surrounding construction and adjacent surfaces.

D. Interface with Other Work. Install items in a sequence to not delay:

1. Adjoining construction.
2. Connections of casework and hoods to mechanical and electrical services.

3.3 SCHEDULES

A. Quantities are indicated on Drawings, unless otherwise indicated.

END OF SECTION 115343

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. This Section includes, but is not limited to, all materials, labor and equipment, complete with all anchors and related accessories, necessary to furnish, deliver and install:

1. DI Polishers
2. Ice Makers
3. Pass-Through Box
4. Dust Extractor Arms
5. Downdraft Booth

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 018113, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. For general requirements applicable to this and all other Laboratory Equipment Specification Sections including, but not limited to definitions, system description, submittals, LEED requirements, quality assurance, mock-up, testing, field measurements, pre-installation conference, delivery, storage and handling, project conditions, and sequencing requirements, refer to Specification Section 115300 - Laboratory Equipment-General Requirements.

PART 2 - PRODUCTS

2.1 GENERAL

A. For general requirements applicable to this and all other Laboratory Equipment Specification Sections including, but not limited to, manufacturers, materials, components, and finish and performance requirements, refer to Specification Section 115300 - Laboratory Equipment-General Requirements.

2.2 DI POLISHERS

A. Acceptable Manufacturers & Products:

1. Millipore Corp., Marlborough, MA (Milli-Q Advantage A10)
2. Sartorius, Edgewood, New York
3. Barnstead/Thermollyne, Dubuque, Iowa

B. Description:

1. The point of use ultra-pure water system with ultrafilter and UV lamp shall provide type I, 18 meg-ohm quality water with <10ppb TOC and <0.001 EU/mL pyrogen levels, at locations indicated on drawings.

2. The unit shall be provided complete with a Remote Dispenser with a graphic display that provides system operation and performance information.
3. Feed Water: RO/DI Water.
4. The system shall be installed complete with interconnecting plumbing and electrical work per the drawings and specifications.
5. The vendor shall supply all of the major system components and necessary cartridges.
6. The system shall be a virtually silent unit, generating less than 40 decibels at a 1 meter distance from the system.
7. It shall be located inside base cabinet adjacent to sink as indicated in the drawings and it shall come complete with a remote dispenser to allow delivery of water.
8. The unit shall have a microprocessor controlled purity monitor and controls for simple and accurate operation.
9. Overall Dimensions: Width: 13”W x 14.25”D x 19.5”H
10. Delivery Unit Dimensions: 9”W x 22.75”H

2.3 ICE MAKERS

A. Acceptable Manufacturers & Products:

1. Hoshizaki America, Inc., Peachtree City, GA (Model # F-300BAF with B5305 Storage Bin)
2. Ice-O-Matic, Denver, CO
3. Scotsman Ice Systems, Vernon Hills, IL

B. Description:

1. Self Contained Flaker with Storage Bins & 6” high legs.
2. Water-cooled flaker with removable, cleanable air filters for more efficient operation and dependable performance.
3. Durable, high grade stainless steel construction.
4. Up to 303 lbs. ice production per 24 hours.
5. Corrosion-resistant stainless steel exterior.
6. Storage Bin Capacity: 110 lbs.

2.4 PASS-THROUGH BOX

A. Acceptable Manufacturers & Products:

1. G2 Automated Technologies, LLC., Dallas, TX (Model EPPT-POLY-SCPT006)
2. Esco Technologies, Inc., Hatboro, PA
3. Terra Universal Inc., Fullerton, CA

B. Description:

1. Pass-through cabinet, including cabinet, all hardware, support brackets, and accessories shall be constructed of ½” thick white polypropylene.
2. Two inner locking (only one door can be opened at a time) doors with installed PVC viewing windows, plastic hinges, and plastic pull latches.
3. Two polypropylene wall mounting flanges for framing both sides of wall openings.
4. Pass-through cabinet shall be 24”W x 24”H x 24”D clear inside dimensions with chamber bottom mounted 36” AFF.
5. Complete with polypropylene mounting brackets..
6. Complete with polypropylene sloped top.

2.5 DUST EXTRACTOR ARMS

A. Acceptable Manufacturers & Products:

1. Airflow Systems Inc., Dallas, TX (Model # E-Z Arm II, High Flow Extractor)
2. Nederman Inc., Wetland, MI
3. Movex Inc., Bath, PA

B. Description:

1. Bench Mounted Local Exhaust shall be designed for use with movable equipment.
2. Epoxy coated aluminum tubing connected with spiral-wire reinforced Hi-Flow hose.
3. Heavy-duty external aluminum joints with external hand knobs for easy joint friction adjustments.
4. Spring-balanced base joint on 8 foot arm.
5. Air flow rate between 200 – 600 CFM.
6. 10” inch diameter hood is spun aluminum, finished with white epoxy powder coat.
7. 4-way movement and a 360° flange handle allow for easier hood positioning.
8. The arm shall be delivered fully assembled including bracket for bench mounting.
9. All outside metal components shall have a chemical and corrosion-resistant, environmentally friendly, electrostatically applied white epoxy powder coat finish.

2.6 DOWNDRAFT BOOTH

A. Acceptable Manufacturers & Products:
1. Dual Draw , Air Cleaning Specialists, Fenton, MO (Model No. TB 3072-5000)
2. Aget Manufacturing, Adrian, MI
3. Diversi-Tech Inc., Sand Antonio, TX
4. Dawson-Macdonald Co Inc., Wilmington, MA

B. Description:
1. TB3072 (30”D X 72”W work surface) Low Flow or High Flow. Filter system designation: D (Dust Collection), F (Smoke/Fume Removal), IS (Internal System), H (HEPA).
2. Patented DualDraw design: even distribution of airflow across a perforated surface and vented back stop. Modular fastening system provides design flexibility to meet customer requirements in a cost-effective manner. Self-contained solution; no outdoor exhausting necessary.
3. Overall dimensions: 72” long x 30” deep x 80” high. Table footprint shall extend an additional 24” D to account for the filter housing.
4. Filtration systems shall attach to the back side of equipment or shall be located internally. Provide HEPA filtration. All filter systems shall come with cleanout trays and easy to remove access doors for filter maintenance.
5. Internal filter systems shall be located inside the table and accessed through a door located on the bottom front. Internal filter systems reduce overall depth by 24”. Cleanout tray for ease of maintenance shall be provided.
6. HEPA filter systems for dust, smoke, or fumes shall be available. HEPA systems can also be located internal. Cleanout tray for ease of maintenance shall be provided.
7. The surface of the downdraft table shall be a series of 5” W perforated C-channel grates. Each grate shall have evenly spaced 1/2” x 3/16” perforations that create an equal distribution of downdraft across the surface.
8. Table Capacity: 500 lbs. - 1,000 lbs. distributed weight. Reinforced grates and table sides shall be provided for heavy-duty use.
9. Cabinet: 12-16 gauge modular body construction.
10. Finish: Electro Galvanized. Powder coat paint finish.
11. Filters:
    A set of new filters shall be included with the unit. The set shall include:
    a. 24” x 24” x 4” pleated pre-filter. 40% efficient to 0.7 microns. MERV 7.
    b. 24” x 24” x 4” pleated final filter. 95% efficient to 0.7 microns. MERV 14.

c. 24” x 24” x 30” 10-pocket dust bag filter. 85% efficient to 1.0 micron. MERV 13.
d. 24” x 24” x 2” activated carbon filter for fume removal. 6 lbs.
e. 24” x 24” x 11.5” HEPA filter. 99.97% efficient to 0.3 microns. MERV 17.
f. 24” x 24” x 12” activated carbon filter. Heavy-duty. 60 lbs.

12. Spark Arrestor: Provide heavy-duty steel spark arrestor to catch residual particulate and reduce fire hazard. Standard equipment for applications that generate hot particulate or spark. Washable.
13. Dust Pans: Provide removable front dust pan, for easy cleanout and maintenance and cleanout tray in filter housing.
14. Electrical: Units shall come pre-wired with a thermally protected manual motor starter and two single phase outlets. Magnetic motor starter shall be provided. Refer to Electrical Drawings for Power Requirements.
15. Lighting: 2 bulb fluorescent fixture.
16. Air Volume Low flow and high flow options available. CFM shall be 3,000. 68% through table surface and 32% through vented back.
17. Sound Ranges: from 70 – 78 dB at operator work zone. Silencer package shall be provided.
18. Magnehelic Gauge: Pressure gauge shall provide indication of when filters should be checked.
19. Caster wheels: Heavy-duty 3.5” caster wheels.
20. Standards: Shall comply with OSHA Standard 1910.1000 (air contaminants).

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS:

A. For General Installation Requirements applicable to this and all other Laboratory Equipment Specification Sections including, but not limited to, examination, installation, adjusting, cleaning, and protection requirements, refer to Specification Section 115300 - Laboratory Equipment-General Requirements.

END OF SECTION 115360

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Roller shades for both manual and motorized shade operators. Motorized shade at locations indicated on the Architectural Drawings, including Conference Rooms, General Purpose Classroom and Department Office Suites.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 06 10 00 - ROUGH CARPENTRY for wood blocking and grounds for mounting roller shades and accessories.
2. Section 092110 - GYPSUM BOARD ASSEMBLIES for coordination and installation of recessed pocket.
3. Section 095110 - ACOUSTICAL CEILINGS for coordination of adjacent ceiling.
4. Division 26 - ELECTRICAL for electrical service and connections for motor operators, controls, limit switches, and other powered devices and for system disconnect switches for motorized shade operation.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions.

1. Motorized Shade Operators: Include operating instructions.
2. Motors: Show nameplate data, ratings, characteristics, and mounting arrangements.

B. Shop Drawings: Show location and extent of roller shades. Include elevations, sections, details, and dimensions not shown in Product Data. Show installation details, mountings, attachments to other work, operational clearances, and relationship to adjoining work.

1. Motorized Shade Operators: Show locations and details for installing operator components, switches, and controls. Indicate motor size, electrical characteristics, drive arrangement, mounting, and grounding provisions.
2. Wiring Diagrams: Power, system, and control wiring.

C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Ceiling suspension system members and attachment to building structure.
2. Ceiling-mounted or penetrating items including light fixtures, air outlets and inlets, speakers, sprinklers, recessed shades, and special moldings at walls, column penetrations, and other junctures of acoustical ceilings with adjoining construction.
3. Shade mounting assembly and attachment.
4. Size and location of access to shade operator and adjustable components.
5. Minimum Drawing Scale: 1/4 inch = 1 foot.

D. Samples for Initial Selection: For each colored component of each type of shade indicated.

1. Include similar Samples of accessories involving color selection.

E. Samples for Verification:

1. Complete, full-size operating unit not less than 16 inches wide for each type of roller shade indicated.
2. For the following products:
   a. Shade Material: Not less than 12-inch- square section of fabric, from dye lot used for the Work, with specified treatments applied. Show complete pattern repeat. Mark top and face of material.
   b. Valance: Full-size unit, not less than 12 inches long.

F. Window Treatment Schedule: For roller shades. Use same designations indicated on Drawings.

G. Product Certificates: For each type of roller shade, signed by product manufacturer.

H. Qualification Data: For Installer.

I. Product Test Reports: For each type of roller shade.

J. Maintenance Data: For roller shades to include in maintenance manuals. Include the following:

1. Methods for maintaining roller shades and finishes.
2. Precautions about cleaning materials and methods that could be detrimental to fabrics, finishes, and performance.
3. Operating hardware.
4. Motorized shade operator.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Approved by manufacturer with minimum of 10 years experience specializing in the installation of shade systems.

B. Source Limitations: Obtain roller shades through one source from a single manufacturer.

C. Fire-Test-Response Characteristics: Provide roller shade band materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. Flame-Resistance Ratings: Passes NFPA 701.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver shades in factory packages, marked with manufacturer and product name, fire-test-response characteristics, and location of installation using same designations indicated on Drawings and in a window treatment schedule.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install roller shades until construction and wet and dirty finish work in spaces, including painting, is complete and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operable glazed units' operation hardware throughout the entire operating range. Notify Architect of discrepancies. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Rollers Shades: Before installation begins, for each size, color, texture, and pattern indicated, full-size units equal to 5 percent of amount installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1. Hunter Douglas Contract; Nysan Shading Systems.
2. Lutron Electronics Co.
3. MechoShade Systems, Inc.

B. Basis-of-Design: Nysan.

2.2 ROLLER SHADES

A. Shade Band Material: PVC-free; 100% polyester, Cradle-to-cradle certified and as follows:

1. Pattern: Green Screen Collection.
2. Style: Eco 300.
3. Colors: Pearl.
4. Material Openness Factor: 3%.
5. Material UV Transmittance: 13.
6. Bottom Hem: Straight.

B. Rollers: Electrogalvanized or epoxy primed extruded-aluminum tube of diameter and wall thickness required to support and fit internal components of operating system and the weight and width of shade band material without sagging; designed to be easily removable from support brackets; with removable spline fitting integral channel in tube for attaching shade material.

1. Direction of Roll: Regular, from back of roller, adjacent to glass.

C. Mounting Brackets: Galvanized or zinc-plated steel.

D. Pocket-Style Headbox: U-shaped, formed-steel sheet or extruded aluminum; long edges returned or rolled; with a bottom cover consisting of slot opening of minimum dimension to allow lowering and raising of shade and a removable or an openable, continuous metal access panel concealing shade roller, brackets, and operating hardware and operators within.

E. Bottom Bar: Extruded aluminum. Provide exposed flat hem bottom bar weighted as required for smooth, properly balanced shade operation.

F. Mounting: As indicated on Drawings, mounting permitting easy removal and replacement without damaging roller shade or adjacent surfaces and finishes.

2.3 ROLLER SHADE FABRICATION

A. Product Description: Roller shade consisting of a roller, a means of supporting the roller, a flexible sheet or band of material carried by the roller, a means of attaching the material to the roller, a bottom bar, and an operating mechanism that lifts and lowers the shade.

B. Concealed Components: Noncorrodible or corrosion-resistant-coated materials.

1. Lifting Mechanism: With permanently lubricated moving parts.

C. Unit Sizes: Obtain units fabricated in sizes to fill window and other openings as follows, measured at 74 deg F:

1. Shade Units Installed between (Inside) Jambs: Edge of shade not more than 1/4 inch from face of jamb. Length equal to head to sill dimension of opening in which each shade is installed.
2. Shade Units Installed Outside Jambs: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.

D. Installation Brackets: Designed for easy removal and reinstallation of shade, for supporting fascia, roller, and operating hardware and for hardware position and shade mounting method indicated.

E. Installation Fasteners: No fewer than two fasteners per bracket, fabricated from metal noncorrosive to shade hardware and adjoining construction; type designed for securing to supporting substrate; and supporting shades and accessories under conditions of normal use.

F. Color-Coated Finish: For metal components exposed to view, apply manufacturer's standard baked finish complying with manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.

2.4 MANUALLY OPERATED SHADES

A. Manual chain Operator:

1. Unitized premoulded construction, on 2.875" x 3", 12 gauge, L shaped, coated steel mounting brackets
2. Operator assembly shall allow for continuous front or back-roll fascia across multiple shades (to a maximum length of 20 ft. without exposed fasteners.
3. Shade brackets shall be shipped completely assembled from the factory.
4. A single manual chain operator as designed by the specified manufacturer shall be capable of operating a shade band up to 56 ft^2 in total fabric area, 7 ft. in width, or 8 ft. in height, and shall be manufactured with a precise inertia brake mechanism capable of locking the shade panel or band at any point of travel. Specifier please note: Should shade panel or band exceed the above dimensions, or if it is desired to drive more than one shade band with one operator, operating hardware should be specified as follows: Chain operator type, Nysan SunriserTM, gear reduction operating hardware, manufactured with a precise inertia braking mechanism to stop shade at any desired point of travel
5. Drive chain to be #10 stainless steel, tested strength of90lb, to eliminate breakage of chain under normal usage
6. Left hand, right hand or dual left and right operating systems
7. Offset drive operators available (chain falls only on one side of bracket). Offset operators shall be standard with blackout fabric shades.

2.5 MOTORIZED ROLLER SHADE OPERATORS

A. General: Provide factory-assembled motorized shade operation systems designed for lifting shades of type, size, weight, construction, use, and operation frequency indicated. Provide operation systems of size and capacity and with features, characteristics, and accessories suitable for Project conditions and recommended by shade manufacturer, complete with electric motors and factory-prewired motor controls, remote-control stations, remote-control devices, power disconnect switches, enclosures protecting controls and all operating parts, and accessories required for reliable operation without malfunction. Include wiring from motor

controls to motors. Coordinate operator wiring requirements and electrical characteristics with the building electrical system.

B. Comply with NFPA 70.

C. Control Equipment: Comply with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6 with NFPA 70, Class 2 control circuit, maximum 24-V ac or dc.

D. Electric Motors: UL-approved or -recognized, totally enclosed, insulated motor, complying with NEMA MG 1, with thermal-overload protection, brake, permanently lubricated bearings, and limit switches; sized by shade manufacturer to start and operate size and weight of shade considering service factor or considering Project's service conditions without exceeding nameplate ratings.

1. Service Factor: According to NEMA MG 1, unless otherwise indicated.
2. Motor Characteristics: Single phase, 220 V, 60 Hz.
3. Motor Mounting: Within manufacturer's standard roller enclosure.

E. Position of Motor and Electrical Connection: Right side of roller, as determined by hand of user facing shade from inside, unless otherwise indicated on Drawings.

F. Remote Controls: Electric controls with NEMA ICS 6, Type 1 enclosure for recessed or flush mounting. Provide the following devices for remote-control activation of shades:

1. Control Stations: Keyed, maintained-contact, three-position, switch-operated control station with open, close, and off functions. Provide two keys per station.
   a. Color: White.
2. Group Control Stations: Maintained-contact, three-position, rocker-style, wall switch-operated control station with open, close, and center off functions for single-switch group control.
   a. Color: White
3. Microprocessor Controls: Electronic programmable means for setting, changing, and adjusting control features. Provide unit isolated from voltage spikes and surges.

G. Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop shade at fully raised and fully lowered positions.

H. Operating Function: Stop and hold shade at any position

I. Operating Features: Include the following:

1. Group switching with integrated switch control; single face plate for multiple switch cut-outs.
2. Capable of interface with audiovisual control system.
3. Capable of accepting input from building automation control system.
4. Override switch.
5. Backup gear and crank operator for manual operation during power failures with detachable handle, length required to make operation convenient from floor level

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.
2. Verify that all required blocking and framing is properly installed and secure.

3.2 ROLLER SHADE INSTALLATION

A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions, and located so shade band is not closer than 2 inches to interior face of glass. Allow clearances for window operation hardware.

B. Connections: Connect motorized operators to building electrical system.

3.3 ADJUSTING

A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

A. Clean roller shade surfaces after installation, according to manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.

C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner’s maintenance personnel to adjust, operate, and maintain roller shades. Refer to Division 01 Sections for contract closeout procedures.

END OF SECTION 12 24 00

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. The casework contractor shall furnish and install all products specified herein and in the complete casework package. The complete casework package consist of the following specification sections:

1. Section 115313 - Fume Hoods
2. Section 115343 - Laboratory Service Fixtures
3. Section 123553 - Laboratory Casework - General Requirements
4. Section 123554 - Metal Laboratory Casework
5. Section 123556 - Plastic Laminate Laboratory Casework
6. Section 123557 - Polypropylene Laboratory Casework

B. This Section includes, but is not limited to, all materials, labor and equipment, complete with all anchors and related accessories, necessary to furnish, deliver and install:

1. Epoxy Resin Countertops, Back Splashes, Sinks and Cup Sinks
2. Peg Boards
3. Hardware and Trim
4. Cylinder Restraints
5. Cylinder Support Racks

C. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 018113, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

1.3 LABORATORY CASEWORK – GENERAL REQUIREMENTS

A. This Section includes, but is not limited to, all materials, labor and equipment, complete with all anchors and related accessories, necessary to furnish, deliver and install:

1. Epoxy Resin Countertops, Shelves, Back Splashes, Sinks and Cup Sinks
2. Stainless Steel Countertops, Back Splashes and Sinks
3. Peg Boards
4. Hardware and Trim
5. Gas Cylinder Supports
6. Cylinder Barricade Racks

B. Although such work is not specifically shown or specified, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.

C. This Section also includes all general requirements, applicable to this and all other Casework Specification Sections including, but not limited to:

Definitions
System description
Scope
Submittals
Quality assurance
Mock-up
Testing
Field measurements
Pre-installation conference
Delivery, storage and handling
Project conditions
Sequencing
Materials
Components
Finish and performance requirements
Examination, Installation, Adjusting, Cleaning and Protection Requirements

D. Related Sections:

1. Division 07 - Sealants
2. Division 11 - Laboratory Equipment
3. Divisions 22 & 23 - Mechanical: service lines, plumbing connections, drains, traps, overflows, strainer, tailpieces, and fittings, ductwork, blowers, fume hood fans, and air flow monitors
4. Division 26 - Electrical: Service lines, electrical rough-in, connections, receptacles, and covers.

1.4 DEFINITIONS

A. Service Fixtures:

1. Plumbing Service Fixtures: Gas, air, vacuum and specialty gas cocks; ball turrets; hot, cold, and ultra-pure water gooseneck faucets; remote control valves; safety eyewash; shower heads; and other fittings.
2. Electrical Service Fixtures: Electrical convenience outlet boxes, electrical pedestals, single or duplex receptacles, switches: etc.
3. Other items which serve as functional part of equipment.

B. Service Lines:

1. Gas, air, and vacuum piping; hot, cold, and ultra-pure water piping; drain and vent lines; fittings; and control and shut off valves; to carry respective services from building roughing-in floors and walls through equipment to service fixtures.
2. Conduit, junction boxes, conduit fitting, wire disconnect switches, fuses, and circuit breakers, to carry electrical services from building roughing-in outlets in floors, and walls through equipment to service fixtures.

C. Exposed:

1. As used in this Specification Section, "exposed" portions of woodwork include surfaces visible when doors and drawers are closed. Bottoms of woodwork more than 4 feet

above finish floor are considered exposed. Visible surfaces in open casework or behind clear doors also are considered as exposed.

D. Semi-Exposed:

1. As used in this Specification Section, "semi-exposed" portions of woodwork include those members behind opaque doors, such as shelves, divisions, interior faces of ends, case backs, drawer sides, backs and bottoms, and back face of doors. Tops of cases 6'-6" or more above finish floor shall be considered semi-exposed. Bottoms of woodwork less than 4 feet above finish floor are considered semi-exposed. Semi-exposed portions of woodwork shall be of same, finish and color as the "exposed" portions.

1.5 SYSTEM DESCRIPTION

A. Design Requirements:

1. Manufacturer is responsible for:
   a. Designing, engineering, fabricating, and installing system
   b. Anchorage to structure
   c. Modifications to meet specified requirements and maintain visual design concepts
2. Drawings are diagrammatic and are intended to establish basic dimension of units, sight lines, and unit profiles.
3. Provide concealed fastening wherever possible.
4. Attachment considerations: Account for site peculiarities, expansion and contraction movements, so there is no loosening, weakening, and fracturing, of connections between units and substrate.
5. Comply with UL 544 for electrically powered equipment.

B. Interface With Adjacent Systems:

1. Coordinate with mechanical service lines and ductwork.
2. Coordinate with electrical service lines.

1.6 SCOPE

A. Furnish and install all cabinets and casework, including tops, ledges, supporting structures, fume hoods, laboratory sinks, cup sinks, and miscellaneous items of equipment as listed in these specifications, including delivery to the building, setting in place, leveling, scribing to walls and floors as required. Furnishing and installing all filler panels, knee space panels and scribes as shown on drawings.

B. Furnish and deliver all utility service outlet accessory fittings, as listed in these specifications or as shown on drawings as mounted on the laboratory furniture. The above defined items shall be furnished unassembled with supply tank nipples and lock nuts, not attached, loose in boxes and properly marked for delivery to the mechanical contractor. All plumbing fittings shall be packaged separately and properly marked for delivery to the appropriate contractor.

C. Furnish and deliver, packed in boxes for installation by the mechanical contractor, all drain troughs and sink outlets with integral tailpieces, which occur above the floor, and where these items are part of the equipment or listed in the specifications, or shown on the drawings. Integral tailpieces when required shall be in accordance with the manufacturer's standards. All tailpieces shall be furnished less the couplings required to connect them to the drain piping system.

D. Furnish service strip supports where specified, and setting in place service tunnels, service turrets, supporting structures and reagent racks of the type shown on the details.

1.7 SUBMITTALS

A. Product Data:

1. Submit manufacturer's descriptive literature and product specifications for each product.
2. Include data to indicate cabinet construction.
3. Include information for factory finishes, chemical resistance ratings, hardware, glass, sealants, accessories, and other required components.

B. Shop Drawings:

1. Indicate typical casework and countertop layout including dimensioned floor plans, sections and elevations, and service fixture holes locations.
2. Indicate enclosures, cabinets, hardware, service fixtures complete with numbers and item names, and details including construction kinds of cabinets, countertops, process tables, and other components.
3. Submit detail drawings of special accessory components not included in manufacturer's product data.
4. Indicate joints in countertop material.

C. Samples:

1. Work Surface Samples:

   a. One sample of all top materials shown or called for, of sufficient size to perform finish requirement tests
   b. Two pieces sealed and joined. Full depth of counter and 6 inches from each side of joint

2. Plastic Laminate Samples:

   a. Include manufacturer's full range of colors for Architect's selection.
   b. Architect will select casework components' color with no change in contract sum.
   c. Provide sample of colors, as selected by Architect.
   d. Size: 6” x 6”

3. Wood Finish Samples:

   a. Include samples. Maple veneer. Custom color to match Architect’s selection.
   b. Provide 12" x 12" sample of colors, as selected by Architect.

4. Metal Casework Color Samples:

   a. Include manufacturer's full range of colors for Architect's selection.
   b. Architect will select casework components' color with no change in contract sum.
   c. Provide sample of colors, as selected by Architect, on same metal from which casework will be fabricated.
   d. Size: 6” x 6”

5. Sample of all mechanical service fittings, locks, door pulls, hinges, and interior hardware.

D. Certification: Submit certifications specified in Quality Assurance article.

E. Qualification Data:

1. Submit manufacturer's and installer's qualifications verifying years of experience.
2. Include list of completed projects having similar scope of Work identified by name, location, date, reference names, and phone numbers.

F. Manufacturer's Instructions: Submit manufacturer's printed installation instructions.

G. Warranty:

1. Submit specified warranty in accordance with Division 01.
2. Warrant installed casework to be free from defects in material and workmanship for 1 year from date of substantial completion.
3. Warrant casework and components to be corrosion free for 3 years from date of substantial completion.
4. Warrant that plastic laminate laboratory casework components will not delaminate due to contact with moisture or chemicals for a period of 5 years.
5. Include coverage against defects which may arise during the warranty period except those which are caused by misuse.

1.8 QUALITY ASSURANCE

A. General Performance: Provide certification that furniture shall meet the performance requirements described in SEFA 8.

B. Single Source Responsibility:

1. Furnish units from one manufacturer for entire Project, unless otherwise acceptable to Architect.
2. Provide casework modules as complete units, including countertop hardware, glazing, service fixtures and accessory items necessary for proper function.
3. Provide each fume hood as a complete unit, including service fixtures specified in Section 115313 and accessory items necessary for operation.

C. Manufacturer Qualifications: Company specializing in manufacturing Products specified in this Section.

D. Installer Qualifications: Acceptable to fabricator with documented experience on at least 5 projects of similar nature in past 5 years.

E. Regulatory Requirements: Ensure flammable components comply with applicable portions of local, state, and federal codes, laws, and ordinances for flame spread and smoke developed indices.

F. LEED Submittals:

1. Recycled Content (MR4): Submit product data or other published information indicating total weight of product to be provided for the Project, percent of post-consumer recycled material by weight and percent of post-industrial recycled material by weight. Include material costs (excluding costs of installation).
2. For Credit (IEQ 4.3): Manufacturers' product data for paints, including printed statement of VOC content.
3. Low-Emitting Composite Wood & Agrifiber Products (EQ4.4): Submit product data or other published information verifying the composite wood, agrifiber products, and laminating adhesives used contain no added urea-formaldehyde resins.

4. Material Source (MR5): Submit product data or other published information verifying the location of manufacturing facility including name, address, and distance between manufacturing facility and the project site. Provide manufacturer's documentation indicating location where the base materials were extracted, mined, quarried, harvested, etc. and the distance between this location and the project site. Also include material costs (excluding costs of installation). Include information on Material Tracking Worksheets.

5. Certified Wood (MR7): Forest Stewardship Council (FSC): Provide letter of certification signed by lumber supplier. Indicate compliance with FSC "Principles for Natural Forest Management" and identify certifying organization. Submit FSC certification numbers; identify each certified product on a line-item basis. Submit copies of invoices bearing the FSC certification numbers.

1.9 PERFORMANCE REQUIREMENTS:

A. Base cabinets shall be constructed to support at least a uniformly distributed load of 200 lbs. per square foot of cabinet top area, including working surface without objectionable distortion of interference with door and drawer operation.

B. Base cabinet corner gussets with leveling bolts shall support 500 lbs. per corner, at 1-1/2" projection of the leveling bolt below the gusset.

C. Each adjustable and fixed shelf 4 ft. or shorter in length shall support an evenly distributed load of 40 lbs. per square ft. up to a maximum of 200 lbs., with nominal temporary deflection, but without permanent set. These requirements apply to all shelves including, but not limited to wall mounted shelves, shelves at island benches, and shelves inside cabinets.

D. Drawer construction and performance shall allow 13-5/8" clear when in an extended position and suspension system shall prevent friction contact with any other drawer or door during opening or closing. All drawers shall operate smoothly, a minimum of 10,000 cycles with an evenly distributed load of 150 lbs.

E. Swinging doors on floor mounted casework shall support 200 lbs. suspended at a point 12" from hinged side. Weight load test shall allow only a temporary deflection, without permanent distortion or twist. Door shall operate freely after test and assume a flat plane in a closed position.

F. Utility Tables (4 legged) shall support 300 lbs. per square foot.

G. Heavy Duty Tables (4 legged) shall support 500 lbs. per square foot.

1.10 MOCK-UP

A. General: Comply with provisions of Division 01.

B. The laboratory furniture manufacturer shall erect a laboratory furniture mock-up, in the location indicated by the Architect. All components utilized shall meet the requirements of the Drawings and Specifications.

C. The manufacturer shall make adjustments necessary to meet minimum performance requirements and testing criteria specified, and obtain acceptance from Owner's Representative. Modifications to the mock-up shall be incorporated into the overall design of the

project without change in contract sum. Do not proceed with shop fabrication or project installation until mock-up has been accepted by Architect.

D. Accepted mock-up establishes minimum performance standards and quality for workmanship and materials for the Project. Mock-up shall remain in designated location until all furniture is installed and approved by the Owner's Representative. Approved mock-up will be incorporated into the project.

E. Mock-up scope shall include one lab, prep room or portion of a lab, and shall incorporate the basic elements of a lab including, but not limited, to a sink and associated counter area, base cabinets with drawers and doors, knee space, wall mounted cabinet, wall mounted shelf, flammable and acid cabinets and fume hood with all necessary surface fixtures and service connection components to make the lab function. Mock-up shall include one cabinet in each color finish selected and approved via sample process.

F. Mock-up location shall be either in a conditioned trailer remaining on site throughout the project (provided by the contractor) or in a conditioned room within the new facility agreed upon by the Owner, Architect, Contractor and Lab Casework & Equipment Provider / Installer. Mock-up shall remain in place the duration of the project and if all components are acceptable, is permitted to become a part of the completed work. If the mock-up is located within a trailer, the components, if approved, may be relocated in the facility at a time approved by the Architect.

1.11 TESTING

A. The laboratory furniture manufacturer shall be required to submit with their bid certified test reports on the laboratory casework finish, all work top materials to be furnished, and hoods. These test reports shall be performed by an independent nationally recognized testing laboratory and shall certify that the materials to be supplied will conform to the requirements of these specifications as well as testing procedures. Failure to include these test reports with the bid might be cause for rejection of the bidder and of the bid proposal.

1.12 FIELD MEASUREMENTS

A. It is the laboratory furniture manufacturer's responsibility to verify all field measurements and that all equipment will fit through entry ways, corridors and door openings enabling a smooth flow of equipment to its proper location in the building.

B. Drawings show arrangement and location of casework. If it is necessary to vary from arrangement shown, because of structural, mechanical, electrical or other considerations make such variations only after approval of Architect and at no additional expense to Owner.

C. Measure all recesses and openings at buildings and provide all trim pieces, fillers, and closures, in sizes required.

1.13 PRE-INSTALLATION CONFERENCE

A. Conduct pre-installation conference in accordance with Division 01.

B. Convene pre-installation conference one week prior to commencing work of this Section.

C. Attendance Required: Owner, Architect, Contractor, Manufacturer's Representative, and Installer.

D. Agenda: Discuss and agree upon acceptable substrate and support conditions, preparatory work, interface with mechanical and electrical services, and methods of installation and testing.

1.14 PROJECT CONDITIONS

A. Environmental Requirements: Comply with manufacturer's written requirements for installing sealants.

B. Do not deliver or install casework until the following conditions have been met:

1. Windows and doors are installed and the building is secure and weather-tight.
2. Ceiling, overhead ductwork and lighting are installed.
3. All painting is completed and floor tile is installed.
4. Do not deliver or install wood product until Interior building temperature is maintained between 65 and 80 degree F, and ambient relative humidity maintained between 25% and 55% prior to delivery, and during and after installation. Frequent and/or excessive changes in temperature and/or humidity levels during casework installation, or once casework is installed, must be avoided to prevent damage to materials.

1.15 SEQUENCING

A. Sequence work under provisions of Division 01.

B. Coordinate with plumbing rough-in requirements specified in Division 22.

C. Coordinate with mechanical requirements specified in Division 23.

D. Coordinate with electrical rough-in requirements specified in Division 26.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. The specific requirements shown and specified are indicated to establish a standard of design and quality for materials, construction, size and workmanship.

B. LEED REQUIREMENTS

1. Comply with requirements specified in Section 018113 “Sustainable Design Requirements & LEED Scorecard”.
2. Give preference to products with materials harvested/extracted/recovered and manufactured/milled within 500 miles of Project site.
3. Give preference to products containing renewable materials.
4. All field-applied paints and coatings used within the building waterproofing envelope shall comply with Section 090007 “Painting” and 090008 “Specialty Painting and Coatings.”

2.2 MANUFACTURERS

A. The specific requirements shown and specified are indicated to establish a standard of design and quality for materials, construction, size and workmanship.

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering

products that may be incorporated into the Work include, but are not limited to, the following:

1. Epoxy Resin Countertops, Shelves, Sinks, Cup Sinks and Peg Boards:
   a. The Durcon Company, Canton, MI
   b. Kewaunee Scientific, Statesville, NC
   c. Thermo Scientific - ALC, Austin, TX

2. Stainless Steel Countertops and Sinks:
   a. Jamestown Metal Products Inc., Jamestown, NY
   b. Kewaunee Scientific, Statesville, NC
   c. Thermo Scientific Hamilton, Two Rivers, WI
   d. Mott Manufacturing Ltd., Brantford, ON

3. Hardware and Trim:
   a. Jamestown Metal Products Inc., Jamestown, NY
   b. Kewaunee Scientific, Statesville, NC
   c. Thermo Scientific - ALC, Austin, TX

4. Gas Cylinder Supports:
   a. Lab Safety Supply, Janesville, WI (Model # 8B-8446)
   b. Praxair, Danbury, CT
   c. Fastenal, Winona, MI

5. Gas Cylinder Barricade Rack:
   a. First Safety Corporation, Wisconsin Rapids, WI
   b. Lab Safety Supply, Janesville, WI
   c. Praxair, Danbury, CT
   d. Fastenal, Winona, MI

C. The Naming of manufacturer(s) and designation of product (s) is for the purpose of identifying and describing required product and not to limit competition. Other manufacturers capable of producing the same appearance and having the same quality, durability, and performance may be proposed for use on this project subject to Architect's approval.

D. Other approved manufacturers are responsible for all adjustments required to fit their products to the work at no additional cost.

2.3 MATERIALS

A. Solid Wood:

1. Exposed solid wood: Maple lumber, clean and free of defect
2. Interior solid wood: Sound hardwood of selected species suitable for intended purpose
3. All lumber kiln dried to uniform moisture content of six percent

B. High Pressure Plastic Laminate:
1. Cabinets: Per requirements of NEMA publication LD3. Vertical Grade, 0.050 inch .
2. Surface Finish: Suede Finish.
3. Color as selected by Architect.
4. Plastic laminate backing sheets: High pressure laminate of paper, without decorative finish, 1/16" inch thick. Formed of papers treated and coated with thermo-setting resins,

pressure bonded to one inch thick 45 lb. density particle board core and backed with melamine backer sheet. Band exposed edges with plastic laminate material.

5. Particle board: ANSI 208.1, Classification M-3

C. Cold Rolled Steel:

1. Cold rolled sheet steel shall be prime grade U.S. Standard; roller leveled, and shall be treated at the mill to be free of scale, ragged edges, deep scratches or other injurious effects.
2. No less than 25% of the steel by weight shall be recycled material.

D. Galvanized Steel:

1. Galvanized steel shall be hot dipped, extra smooth, G90, and shall be free of scale, ragged edges, deep scratches or other injurious effects.

E. Glue: Type 2 or Type 3 water resistant glue.

F. Epoxy Resin:

1. Modified epoxy resin compounded and cured for optimum physical and chemical resistant properties.
2. Uniform mixture throughout full thickness.
3. Non-glaring sheen.
4. Color: Black.
5. Countertop, shelf and back splash thickness: 1 inch
6. Slab flatness: No gap exceeding 0.09 inches in 96 inch span, measured in an unrestrained condition.

G. Glass:

1. Type: Laminated safety glass.
2. Color: Clear.
3. Thickness: 1/4 inch nominal

   a. Outer light: 1/8 inch
   b. Plastic inner layer: 0.030 inch polyvinylbutyral, clear
   c. Inner light: 1/8 inch

4. Glass used for unframed sliding doors shall be ¼” float glass.

H. Epoxy Resin Cement:

1. Suitable for use in joining sections of epoxy resin countertop, backsplashes, and sinks.
2. Sufficient adhesion properties at temperatures 40 degrees to 100 degrees Fahrenheit for permanently anchoring epoxy resin countertops to base cabinets.
3. Chemical resistance equal to that specified for epoxy resin countertops and sinks.
4. Loss of hardness and adhesion properties at temperatures in excess of approximately 140 degrees Fahrenheit.
5. Color to match epoxy resin countertops and sinks.

I. Silicone Sealant: Comply with requirements for Silicone Sanitary Sealant specified in Division 07.

J. Galvanizing Touch-up Paint: SSPC Paint 20.

K. Stainless Steel Sheet Panels:

1. ASTM A167
2. UNS Number S30200 or S30400 and S31603 (316L)
3. Location:

a. Countertops win integral sinks and back splashes (S31603)
b. Base and Wall Cabinets (S30200 or S30400)

L. Stainless Steel Tubing:

1. ASTM A554
2. UNS Number S30200 or S30400

M. Stainless Steel Bars and Shapes:

1. ASTM A276
2. UNS Number S30200 or S30400

N. Sound Deadening: Heavy bodied resinous coating, with resilient filler material, compounded for permanent, non-flaking adhesion to metal in 1/8 inch thick coating.

2.4 COMPONENTS

A. Epoxy Sinks:

1. Material: Epoxy Resin.
2. Construction: Taper side of sink. Inside corners radiused. Pitch bottom of sink to drain.
3. Size: See drawings.
4. Epoxy Sink Supports: Steel channels attached to sink cabinet ends and screw type adjustable rods to insure tight fit to underside of table with a water-proof compound.
5. Support Struts: Support struts shall consist of two 16 gauge channel uprights fastened top and bottom by two adjustable “U” shaped spreaders, each 12 gauge, 1-1/2” x length required. Struts shall be furnished to support drain troughs, and to support work top at plumbing space under fume hood superstructures or other heavy loads. They shall be fabricated so as to accept industry standard, pipe and conduit hangers.
6. Seal around drain with silicone sealant as recommended by epoxy sink manufacturer, and as specified in Division 07. Plumbers putty is not acceptable.

B. Stainless Steel Sinks:

1. Sinks integral with stainless steel countertops: Weld-in with seams ground smooth and polished to match countertop finish.

a. Fabricate stock-sized sinks from deep drawn single sheets
b. Fabricate non-stock sized sinks having joints continuous heliarc welded, ground and polished smooth joints
c. Use stainless steel to fabricate integral sink of same type as adjacent stainless steel countertop
d. Interior coved corners with bottom pitched toward drain

2. Size: See drawings.
3. Free-standing Stainless Steel Sinks: See Division 22.

4. Sinks in non-laboratory areas: See Division 22.

C. Sink Strainer and Tailpieces:

1. Sink strainer and tailpieces:

   a. Epoxy Sinks: See Division 22. Coordinate size of drainage hole with Division 22. Coordinate tailpiece termination with service line connection requirements.
   b. Stainless Steel Sink: See Division 22.

D. Epoxy Resin Countertops and Back Splashes:

1. Fabricate from epoxy resin unless otherwise noted in drawings.
2. Provide back splashes at rear of countertop and on end returns where indicated; notched as required.
3. Fabricate to install without field cutting or drilling. Drill holes in counter for laboratory service fixtures as scheduled in Section 123090.
4. Seal gap between back splash and wall with acrylic latex sealant specified in Division 07.
5. Joint between segments of tops and back splashes:

   a. Smooth, even, and level with no raised edges
   b. Width: 1/8 inch maximum
   c. Seal watertight with modified epoxy resin cement
6. Epoxy Resin countertops:

   a. Cut to size of cabinet or knee space below, where indicated on drawing. Where no indication is made, countertops lengths shall be at Contractor's option with termination points at base cabinet or knee space edges.
   b. Do not cut to be smaller than 24 inches wide.
   c. Fabricate with drip grooves on underside of exposed edges.
   d. Fabricate exposed edges of base sections of countertops with a 1/4 inch chamfer on front top edge, square bottom edge, and vertical corners; fabricate other countertop edges with square tops and bottoms.
   e. Bond back splash to surface of countertop to form square joint.
   f. Back splash to be 4 inches high, unless otherwise noted on Drawings.

E. Solid Maple Butcher Block Workbench Top:

1. Basis of Design: Bally Block Co., Petoskey, MI 49770 (Bally Block with Durakryl 102 finish).
2. Product Description: 1 3/4 " thick. Solid northern hard maple butcher block workbench top with radius top edge.

   a. Finish: Non-toxic acrylic coating with excellent toughness and mar resistance.

F. Phenolic Resin Countertops and Back Splashes:

1. Fabricate from phenolic resin unless otherwise noted in drawings.
2. Countertop above sink cabinets shall be provided with marine edge around four sides to create a dished construction.
3. Provide back splashes at rear of countertop and on end returns where indicated; notched as required.
4. Fabricate to install without field cutting or drilling. Drill holes in counter for laboratory service fixtures as scheduled in Section 12309.
5. Seal gap between back splash and wall with sealant specified in Section 07920.

6. Joint between segments of tops and back splashes:
   a. Smooth, even, and level with no raised edges
   b. Width: 1/16 inch (1.5 mm) maximum
   c. Seal watertight with modified epoxy resin cement
7. Phenolic Resin countertops:
   a. Cut to size of cabinet or knee space below, where indicated on drawing. Where no indication is made, countertops lengths shall be at Contractor's option with termination points at base cabinet or knee space edges.
   b. Do not cut phenolic top in sections smaller than 24 inches wide.
   c. Fabricate with drip grooves on underside of exposed edges.
   d. Fabricate exposed edges of base sections of countertops with a 1/4 inch radius at front top edge, square bottom edge, and vertical corners; fabricate other countertop edges with square tops and bottoms.
   e. Bond back splash to surface of countertop to form square joint.
   f. Back splash to be 4 inches high, unless otherwise noted on Drawings.
   g. Cutouts for drop-in sinks shall be routed to form openings with 3/8" minimum depth supporting flanges and such that the rim of the sink when installed is at the same level as the work surface top. Epoxy sinks shall be set in beds of epoxy adhesive. Stainless steel and polypropylene sinks shall be set in beds of silicone sealant.
   h. Cutouts for under-mounted sinks shall be routed and sanded to form smooth edged openings with the top edge radiused to approximately 1/8". The bottom edge of the sink opening shall be finished smooth with the edge broken to prevent sharpness. Corners of sink cutouts shall be radiused not less than 3/4". Under-mounted sinks shall be supported by brackets blind-fixed to the underside of the work surface.

G. Stainless Steel Countertops:

1. Construct countertops with raised front rim, marine edge construction to match existing adjacent fabrications.
2. Integrally and slightly radius joint where rear curb meets horizontal surface with radius dimension to match existing adjacent fabrication.
3. Weld carbon steel channels to underside in at least three locations along length to prevent twisting, oil canning, and buckling of surface.
4. Apply one coat of sound deadening material to underside but not to visually exposed surfaces.
5. Fabricate tops as single units; longest lengths as practical.
6. Provide field joints to join existing tops and work of this Section with welded channels and angles with bolting arrangements to pull tops together forming hair-line seam. Weld, grind smooth, and polish seams and joints to match adjoining surfaces.
7. Develop maximum strength and rigidity in construction and design of each fabrication.
8. Fabricate each sectional unit ready for placement in casework and equipment assembly.
   a. Fabricate as complete integral rigid unit in itself.
   b. Screw fasteners: Do not use in fabrication of units.
   c. Reinforce with galvanized steel hat sections with cross braces spaced no greater than 30 inches apart.
   d. Turn splash up, height to match existing adjacent fabrication.
   e. Turn splash back, dimension to match existing adjacent fabrication.
   f. Weld turned-up and turned-back portions together.

H. Peg Boards:

1. Constructed of modified epoxy resin.

2. Thickness: 1 inch
3. Color: To match adjacent counter tops.
4. Polish front surface, back surface, and edges.
5. Fabricate with:
    a. 30 inch high removable round-tip polypropylene peg section. Omit bottom row as required to avoid conflict with faucets
    b. Stainless steel drip trough with 1/4 inch diameter outlet below peg area
    c. Flexible clear tubing between drip trough outlet and sink (cut as required)
6. Mechanically fasten drip trough to pegboard and continuously seal with sanitary silicone specified in Division 07 at top edge.

I. Hardware and Trim:
1. Drawer and Door Pulls:
   Drawer and door pulls shall be satin finish stainless steel wire pulls, and shall be securely fastened to doors and drawers with vandal-proof screws. Two pulls shall be required on all drawers over 24 inches long. Drawer pulls shall be mounted horizontally. Door pulls shall be mounted vertically.
2. Drawer Suspension:
   Provide full-extension, heavy duty drawers suspension.
   Loading capacity of 150 lbs. minimum.
   Available manufacturer meeting specification requirements: Fulterer Drawer slide Systems, FR5755 Series Ball bearing Full-Extension Drawer Slide (0104#143).
3. Drawer Stops:
   Provide on drawers to prevent inadvertent removal.
4. Hinges:
   Hinges shall be the five (5) knuckle institutional. Hinges shall be 2-1/2" long, one (1) pair for doors under 4 ft in height and 1-1/2 pair on doors over 4 ft in height. Hinges shall be mounted with flathead screws, so applied to door and cabinet to withstand a weight load of 150 lbs. minimum. All hinges shall be satin finish stainless steel.
5. Locks:
    a. Locks shall be a National Lock, pin tumbler with heavy duty interchangeable cylinder. Exposed lock noses shall be dull nickel (satin) plated and stamped with identifying numbers. Locks shall have capacity of at least 1000 primary key changes.
    b. Provide locks where noted on lab plans.
    c. Keying:
        1) Key locks individually; two keys per lock.
        2) Master key locks by lab suite; two keys per suite.
        3) Provide two grand master keys for locks
6. Roller Catches:
   Roller catches shall be used on swinging doors. Catches shall have a spring-loaded polyethylene roller and provided with a steel strike plate. Double-doors, without looks shall have a catch on each door. Full height cases shall have latching devices located on the structurally fixed center shelf. The left hand door shall have a positive catch and the right hand door shall have the roller type catch.
7. Elbow Catches:
   Elbow catches and strike plates shall be used on left hand doors of double door cases and are to be cast aluminum with bronze finish.
8. Leg Shoes:
   Leg shoes shall be provided on all table legs, unless otherwise specified, to conceal leveling device. Shoes shall be 2-1/2" high and a pliable, black vinyl material. Use of a leg shoe which does not conceal leveling device will not be acceptable.
9. Shelf Support Clips:

Shelf support clips for wood casework shall be pin type for mounting on interior of cabinet work. Clips shall be corrosion resistant and shall retain shelves from accidental removal. Shelves shall be adjustable on 1-1/4" centers. Surface mounted metal support strips and clips subject to corrosion are not acceptable.

10. Fasteners and Anchors:
    Size and type to securely fasten and anchor items to substrates and supporting structure.
11. Dowels:
    Dowels used to join frames and panels shall be fluted hardwood not less than 3/8” in diameter.
12. Label Holders:
    Label holders, where shown or called for, shall be aluminum brad-attached type with satin finish and designed for 2-1/2” x 1-1/8” cards, unless otherwise specified.
13. Number Plates:
    Number plates, where shown or called for, shall be aluminum brad-attached type with satin finish and indented black lettering.

J. Accessories:

1. Gas Cylinder Supports:
   Aluminum cylinder supports to hold 4-1/2" to 14" diameter cylinders upright and ready to use, with safety strap and chain. Provide with safety reminder on both sides of buckle, and spring catch buckle. Attach to wall, as indicated on drawings.
2. Gas Cylinder Barricade Racks:
   a. Tube style racks for safely holding cylinders while in use connected to distribution changeover manifold.
   b. Construction of 2 inch square steel heavy gauge (.125” wall) tubes welded and sealed with powder coated epoxy.
   c. Two levels of welded steel chains with snaps on each end.
   d. Size for number of cylinders indicated on drawings.
   e. Meet or exceed requirements for UFC, NFPA, CGA, OSHA, and Seismic Zone 4 requirements.

2.5 FINISH AND PERFORMANCE REQUIREMENTS

A. Environmental Standards:

1. The finish must be low VOC and reclaimable with enclosed spray and/or roll coat application; thus providing an environmentally responsible product.

B. Wood Finish and Performance Requirements:

1. Wood Surface Preparation:
   Prior to application of wood finish, all cabinet component surfaces shall be sanded smooth to remove loose fibers, scratch marks, and abrasions, with all dust thoroughly removed
2. Wood Finish Application:
   Cabinet components shall be finished using a state of the art flat-line system. The finish shall be applied under controlled conditions prior to casework assembly and attachment of hardware. This will provide maximum coverage and protection to the assembled product. The finish shall be fully UV cured to ensure proper performance.
3. Wood Casework Finish:
   The completed product shall meet the performance test requirements specified under PERFORMANCE TEST RESULTS and SEFA.

C. Steel Finish:

1. After cold rolled steel component parts have been completely fabricated and before finishing, they shall be given a pre-paint treatment to provide excellent adhesion of the finish system to the steel and to aid in the prevention of corrosion. Physical and chemical cleaning of the steel shall be accomplished by washing with an alkaline cleaner, followed by a spray treatment with a complex metallic phosphate solution to provide a uniform fine grained crystalline phosphate surface that shall provide both an excellent bond for the finish and enhance the protection provided by the finish against humidity and corrosive chemicals.
2. After the phosphate treatment, the steel shall be dried and all steel surfaces shall be coated with a chemical and corrosion-resistant, environmentally friendly, electrostatically applied powder coat finish. All components shall be individually painted, insuring that no area be vulnerable to corrosion due to lack of paint coverage. The coating shall then be cured by baking at elevated temperatures to provide maximum properties of corrosion and wear resistance.
3. The completed finish system in standard colors shall meet the performance test requirements specified under PERFORMANCE TEST RESULTS and SEFA.

D. Performance Test Results (Chemical Spot Tests):

1. Testing Procedure:
Chemical spot tests for non-volatile chemicals shall be made by applying 5 drops of each reagent to the surface to be tested and covering with a 1-1/4" dia. watch glass, convex side down to confine the reagent. Spot tests of volatile chemicals shall be tested by placing a cotton ball saturated with reagent on the surface to be tested and covering with an inverted 2-ounce wide mouth bottle to retard evaporation. All spot tests shall be conducted in such a manner that the test surface is kept wet throughout the entire test period, and at a temperature of 77° ±3° F. For both methods, leave the reagents on the panel for a period of one hour. At the end of the test period, the reagents shall be flushed from the surface with water, and the surface scrubbed with a soft bristle brush under running water, rinsed and dried. Volatile solvent test areas shall be cleaned with a cotton swab soaked in the solvent used on the test area. Immediately prior to evaluation, 16 to 24 hours after the reagents are removed, the test surface shall be scrubbed with a damp paper towel and dried with paper towels.

2. Test Evaluation:
Evaluation shall be based on the following rating system.
Level 0 - No detectable change.
Level 1 - Slight change in color or gloss.
Level 2 - Slight surface etching or severe staining.
Level 3 - Pitting, cratering, swelling, or erosion of coating. Obvious and significant deterioration.
After testing, panel shall show no more than three (3) Level 3 conditions.

3. Test Reagents:
Evaluation shall be based on the following rating system.

Test No.	Chemical Reagent	Test Method
1.	Acetate, Amyl	Cotton ball & bottle
2.	Acetate, Ethyl	Cotton ball & bottle
3.	Acetic Acid, 98%	Watch glass
4.	Acetone	Cotton ball & bottle
5.	Acid Dichromate, 5%	Watch glass
6.	Alcohol, Butyl	Cotton ball & bottle

7.	Alcohol, Ethyl	Cotton ball & bottle
8.	Alcohol, Methyl	Cotton ball & bottle
9.	Ammonium Hydroxide, 28%	Watch glass
10.	Benzene	Cotton ball & bottle
11.	Carbon Tetrachloride	Cotton ball & bottle
12.	Chloroform	Cotton ball & bottle
13.	Chromic Acid, 60%	Watch glass
14.	Cresol	Cotton ball & bottle
15.	Dichlor Acetic Acid	Cotton ball & bottle
16.	Dimethylformanide	Cotton ball & bottle
17.	Dioxane	Cotton ball & bottle
18.	Ethyl Ether	Cotton ball & bottle
19.	Formaldehyde, 37%	Cotton ball & bottle
20.	Formic Acid, 90%	Watch glass
21.	Furfural	Cotton ball & bottle
22.	Gasoline	Cotton ball & bottle
23.	Hydrochloric Acid, 37%	Watch glass
24.	Hydrofluoric Acid, 48%	Watch glass
25.	Hydrogen Peroxide, 3%	Watch glass
26.	Iodine, Tincture of	Watch glass
27.	Methyl Ethyl Ketone	Cotton ball & bottle
28.	Methylene Chloride	Cotton ball & bottle
29.	Mono Chlorobenzene	Cotton ball & bottle
30.	Naphthalene	Cotton ball & bottle
31.	Nitric Acid, 20%	Watch glass
32.	Nitric Acid, 30%	Watch glass
33.	Nitric Acid, 70%	Watch glass
34.	Phenol, 90%	Cotton ball & bottle
35.	Phosphoric Acid, 85%	Watch glass
36.	Silver Nitrate, Saturated	Watch glass
37.	Sodium Hydroxide, 10%	Watch glass
38.	Sodium Hydroxide, 20%	Watch glass
39.	Sodium Hydroxide, 40%	Watch glass
40.	Sodium Hydroxide, Flake	Watch glass
41.	Sodium Sulfide, Saturated	Watch glass
42.	Sulfuric Acid, 33%	Watch glass
43.	Sulfuric Acid, 77%	Watch glass
44.	Sulfuric Acid, 96%	Watch glass
45.	Sulfuric Acid, 77% and Nitric Acid, 70%, equal parts	Watch glass
46.	Toluene	Cotton ball & bottle
47.	Trichloroethylene	Cotton ball & bottle
48.	Xylene	Cotton ball & bottle
49.	Zinc Chloride, Saturated	Watch glass

* Where concentrations are indicated, percentages are by weight.

E. Performance Test Results (Heat Resistance):

1. Hot water (190° F - 205° F) shall be allowed to trickle (with a steady stream at a rate not less than 6 ounces per minute) on the finished surface, which shall be set at an angle of 45° from horizontal, for a period of five minutes. After cooling and wiping dry, the finish shall show no visible effect from the hot water treatment.

F. Performance Test Results (Impact Resistance):

1. A one-pound ball (approximately 2" diameter) shall be dropped from a distance of 12 inches onto the finished surface of a 3/4" thick plywood panel supported underneath by a solid surface and onto the finished surface of steel panel supported underneath by a solid surface.. There shall be no evidence of cracks or checks in the finish due to impact upon close eye-ball examination.

G. Performance Test Results (Moisture Resistance) (Plywood only):

1. A cellulose sponge (2" x 3" x 1") shall be soaked with water and placed on the finished surface for a period of 100 hours. The sponge shall be maintained in a wet condition throughout the entire test period. At the end of the test period, the surface shall be dried and no visible effect shall be shown on the finish.

H. Performance Test Results (Bending Test) (Steel only):

1. An 18 gauge steel strip, finished as specified, when bent 180° over a 1/2" diameter mandrel, shall show no peeling or flaking off of the finish.

I. Performance Test Results (Adhesion) (Steel only):

1. Ninety or more squares of the test sample shall remain coated after the scratch adhesion test. Two sets of eleven parallel lines 1/16" apart shall be cut with a razor blade to intersect at right angle thus forming a grid of 100 squares. The cuts shall be made just deep enough to go through the coating, but not into the substrate. They shall then be brushed lightly with a soft brush. Examine under 100 foot-candles of illumination. Note: This test is based on ASTM D2197-68, "Standard Method of Test for Adhesion of Organic Coatings".

J. Performance Test Results (Hardness) (Steel only):

1. The test sample shall have a hardness of 4-H using the pencil hardness test. Pencils, regardless of their brand are valued in this way: 8-H is the hardest, and next in order of diminishing hardness are 7-H, 6-H, 5-H, 4-H, 3-H, 2-H, F, HB, B (soft), 2-B, 3-B, 4-B, 5-B (which is the softest).
2. The pencils shall be sharpened on emery paper to a wide sharp edge. Pencils of increasing hardness shall be pushed across the paint film in a chisel-like manner until one is found that will cut or scratch the film. The pencil used before that one-that is, the hardest pencil that will not rupture the film-is then used to express or designate the hardness.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions and proceed with work in accordance with specifications.

3.2 INSTALLATION

A. Install in accordance with manufacturer's printed instructions and approved shop drawings.

B. Install items plumb, level, square, and free from warp and twist.

C. Maintain dimensional tolerances and alignment with surrounding construction and adjacent surfaces.

D. Install miscellaneous filler panels and scribes for a continuous tight-fitting assembly without gaps and spaces between cabinets, counters, service chase, and adjoining surfaces.

E. Seal backsplashes at wall surfaces.

F. Interface with Other Work. Install items in a sequence to not delay:

1. Adjoining construction
2. Connections of casework and hoods to mechanical and electrical services

3.3 ADJUSTING

A. Adjust parts for smooth, uniform operation.

3.4 CLEANING

A. Comply with manufacturer cleaning instructions.

B. Do not use materials and methods, which may damage finish and surrounding construction.

3.5 PROTECTION

A. Protect finished work.

B. Advise contractor of procedures and precautions for protection of material, installed laboratory casework and fixtures from damage by other trades.

C. Post casework completion notices to alert other trades to the potential damage to completed work as required.

END OF SECTION 123553

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. This Section includes, but is not limited to, all materials, labor and equipment, complete with all anchors and related accessory, necessary to furnish, deliver and install:

B. Metal Casework including:

1. Acid Storage Cabinets for Use Under Fume Hoods
2. Solvent Storage Cabinets for Use Under Fume Hoods
3. Full Height Acid Storage Cabinets
4. Full Height Solvent Storage Cabinets
5. Geology Specimen Cabinets
6. Map Cabinets
7. Miscellaneous fillers and panels required for a finished installation

C. Although such work is not specifically shown or specified, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.

D. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 018113, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

E. For general requirements, applicable to this and all other Casework Specification Sections including, but not limited to definitions, system description, submittals, LEED requirements, quality assurance, mock-up, testing, field measurements, pre-installation conference, delivery, storage and handling, project conditions, and sequencing requirements, refer to Specification Section 123553 - Laboratory Casework-General Requirements.

F. Products Installed But Not Specified Under This Section:

1. Section 115343 - Laboratory Service Fixtures: Supply of service fixtures for fume hoods for placement under this Section.

PART 2 - PRODUCTS

2.1 GENERAL

A. For general requirements, applicable to this and all other Casework Specification Sections including, but not limited to, manufacturers, materials, components, and finish and performance requirements, refer to Specification Section 123553 - Laboratory Casework-General Requirements.

2.2 METAL LABORATORY CASEWORK

A. This Section includes, but is not limited to, all materials, labor and equipment, complete with all anchors and related accessory, necessary to furnish, deliver and install:

1. Special Purpose Cabinets for Use under Fume Hoods
2. Full Height Flammable and Acid Storage Cabinets
3. Stainless Casework including:

a. Floor Mounted Metal Base Cabinets
b. Wall Mounted Metal Shelves
c. Miscellaneous fillers and panels required for a finished installation

2.3 GENERAL

A. For general requirements, applicable to this and all other Casework Specification Sections including, but not limited to, manufacturers, materials, components, and finish and performance requirements, refer to Specification Section 123553 - Laboratory Casework-General Requirements.

2.4 MANUFACTURERS

A. Acceptable Manufacturers:

1. Metal casework, and miscellaneous fillers and panels required for a finished installation:

a. Jamestown Metal Products, Inc., Jamestown, NY
b. Kewaunee Scientific Corporation, Statesville, NC
c. Thermo Scientific Hamilton, Two Rivers, WI

2.5 SPECIAL PURPOSE CABINETS FOR USE UNDER FUME HOODS:

A. Acid Storage Cabinets:
Where indicated acid storage cabinets shall use the same gauges of steel and construction features as other base cabinets. In addition, they shall have a one-piece liner insert made of linear low-density polyethylene. The liner insert shall form a one-inch pan at the bottom to retain spillage. Each door will have a set of louvers at the top and bottom. The door shall be lined with a polyethylene sheet. Each cabinet shall be vented into the fume hood with a 1-1/2" vent pipe, providing a positive airflow directly into the fume hood exhaust system.

B. Solvent Storage Cabinets:
Solvent storage cabinets shall be UL labeled and specifically designed for the storage for the storage of flammable and combustible liquids. Construction shall be based upon the requirements listed by UL, UFC, OSHA, and NFPA No. 30 - 2003. The bottoms, top, sides and doors shall be fabricated of 18 gauge steel and shall be all double panel construction with a 1-1/2" air space between panels. All joints shall be welded, or screwed, to provide a rigid enclosure. The doors shall swing on full-length stainless steel piano hinges and shall be fully insulated. The right hand door shall be equipped with a three point latching device and the left-hand door shall have a full height astragal. The doors shall be self-closing and synchronized so that both doors will always fully close. The right hand door shall be equipped with a three-point latching system that automatically engages when the doors close. Each door shall be equipped with a fusible-link hold-open feature that will ensure the door closes should the temperature outside the cabinet exceed 165 degrees Fahrenheit. Units 24" long shall have only one door,

self-closing, and equipped with a three-point latching system and hold-open feature. A 2" deep liquid tight pan that covers the entire bottom of the cabinet shall be furnished to contain liquid leaks and spills. A full-depth adjustable shelf shall also be provided. Two diametrically opposed vents with spark screens shall be provided in the back of the cabinet as well as a grounding screw. The cabinet shall have an interior finish the same as the exterior and shall be labeled: "FLAMMABLE - KEEP FIRE AWAY".

C. Vacuum Pump Cabinets:

1. Vacuum Pump Storage Cabinets shall be designed without a bottom to allow vacuum pumps, shelving units and other equipment to be rolled in or out of the cabinets.
2. The toe space rail shall be attached to the door to allow total access to the cabinet.
3. The interior shall be lined with 1” thick neoprene foam for sound deadening and easy cleaning.
4. Each cabinet shall be furnished with a 120 VAC, 20 amp, duplex receptacle mounted in the top front rail.
5. Provide a pilot lighted toggle switch mounted in the top front rail.
6. Cabinets shall also be furnished with a 2” diameter vent pipe for venting connections, or access to the hood above.

2.6 FULL HEIGHT FLAMMABLE AND ACID STORAGE CABINETS:

A. Acceptable Manufacturers:

1. Justrite, Des Plaines, IL
2. Secureall Safety Storage Equipment, Laporte, IN
3. SciMatCo, Scientific Materials Company, Batavia, IL

B. Solvent Storage Cabinets:

1. Solvent storage cabinets shall be UL labeled and specifically designed for the storage for the storage of flammable and combustible liquids. Construction shall be based upon the requirements listed by UL, UFC, OSHA, and NFPA No. 30 - 2003.
2. The bottoms, top, sides and doors shall be fabricated of 18 gauge steel and shall be all double panel construction with a 1-1/2" air space between panels. All joints shall be welded, or screwed, to provide a rigid enclosure. The doors shall swing on full-length stainless steel piano hinges and shall be fully insulated. The right hand door shall be equipped with a three point latching device and the left-hand door shall have a full height astragal. The doors shall be self-closing and synchronized so that both doors will always fully close. The right hand door shall be equipped with a three-point latching system that automatically engages when the doors close. Each door shall be equipped with a fusible-link hold-open feature that will ensure the door closes should the temperature outside the cabinet exceed 165 degrees Fahrenheit. Units 24" long shall have only one door, self-closing, and equipped with a three-point locking system and hold-open feature.
3. A 2" deep liquid tight pan that covers the entire bottom of the cabinet shall be furnished to contain liquid leaks and spills.
4. A full-depth adjustable shelf shall also be provided. The shelves shall have built-in troughs to catch incidental drips and easy adjust on 2 ¼” centers for versatile storage. Heavy-gauge galvanized steel shelves, ribbed for extra strength to support 350 lb., weight capacity shall be provided.
5. Two diametrically opposed vents with spark screens shall be provided in the back of the cabinet as well as a grounding screw.
6. The cabinet shall have an interior finish the same as the exterior and shall be labeled: "FLAMMABLE - KEEP FIRE AWAY".

C. Acid Storage Cabinets:

1. Acid storage cabinets shall have the same quality features specified for flammable cabinets, including double wall, 18-fauge, welded steel construction, adjustable selves, three-point self latching doors and level feet.
2. A one-piece liner insert made of linear low-density polyethylene shall be provided. The liner insert shall form a two-inch pan at the bottom to retain spillage. The door shall be lined with a polyethylene sheet. Two diametrically opposed vents with spark screens shall be provided in the back of the cabinet as well as a grounding screw.

D. Combination Corrosive and Flammable Storage Cabinets:

1. Combination cabinets shall be constructed of 1” thick multi-ply, exterior grade plywood with chemical-resistant paint.
2. All cabinets shall be constructed to meet and exceed all applicable NFPA and OSHA standards.
3. Individual cabinets shall be designed for stacking.
4. Cabinets shall be easily identified by cabinet color and 10” hazard label.
5. All cabinets shall have a liquid-tight, 2” trough to contain accidental spills.
6. Flammables cabinets shall be provided with self-closing doors.

2.7 GEOLOGY SPECIMEN CABINETS

A. Acceptable Manufacturers:

1. Lane Science, New York, NY
2. Viking Metal Cabinet Co., Chicago, ILL
3. Delta Designs, Ltd., Topeka, KS

B. Description:

1. Geology Specimen Cabinets shall be designed for the proper and permanent protective storage of heavy rocks and fossils. They shall be fabricated from cold rolled highest quality furniture steel, free from all rust and scale. Double call construction.
2. The cabinets shall be all extremely durable, constructed to accommodate heavy specimens. The cabinets shall also be reinforced for stacking, allowing one cabinet to be placed on top of another. When not stacked, the top of the cabinet shall provide a sturdy work surface.
3. Dimensions: 36 7/8" H X 29" W X 31 15/16" D
4. Doors:
   a. Reinforced doors. The center vertical section shall prevent twisting of door and assure total contact to the seal.
   b. Elastomeric door seals
   c. Safe type lift-off hinge.
   d. Key lock.
5. Chrome label holder shall fit standard 3” x 5” cards.
6. Trays:
   a. Provide cabinets complete with trays. The cabinet shall hold a maximum of 16 trays.
   b. The trays shall be 20 gauge steel with two chrome-plated handles and a large label holder.
   c. Trays shall also feature a no sag bottom, reinforced channel slides, and smooth double thick edges.
   d. Dimensions: 1 7/8" H X 24 15/16" W X 30" D.

7. Cabinets shall be provided with a 16-gauge steel frame, which raises the cabinet four inches off the floor.

2.8 MAP CABINETS

A. Acceptable Manufacturers:

1. Safco Products Company, New Hope, MN
2. Spectra Associates, Inc., Delmar, NY
3. Thermo Scientific Hamilton, Two Rivers, WI

B. Description:

1. Powder coated steel flat file map cabinet with integral top.
2. Cabinets shall be stackable and bolted up to five cabinets high.
3. Each drawer has front metal plan depressor with rear hood.
4. Provide drawers with label holder and chrome pull handles.
5. Inside drawer height is 2”.
6. Provide flush base where indicated on the drawings.
7. Outside dimensions: 15 3/8" High – 53 3/4" Width – 41 3/8" Depth.
8. Inside dimensions: 2" High – 50" Width – 38 3/4" Depth.

2.9 ACCESSORIES

A. Fasteners and Anchors: Size and type to securely fasten and anchor items to substrates and supporting structure.

B. Provide miscellaneous fillers and panels required for a finished installation.

2.10 STAINLESS STEEL CASEWORK

A. Construction:

1. All units shall be flush front construction with intersection of vertical and horizontal case members, such as end panels, top rails, bottoms and vertical posts in same plane without overlap. Exterior corners shall be spot welded with heavy back up reinforcement at exterior corners. All face joints shall be welded and ground smooth to provide a continuous flat plane.
2. All units shall have a cleanable smooth interior. Bottom shall be the pan type with both sides and back formed up for easy cleaning. Bottoms with pans turned down must be caulked around inside perimeter. Fabricate concealed surfaces of inner and outer pans from same finish as exposed surfaces.
3. Unless otherwise indicated all casework units shall be fabricated of stainless steel.
4. Toe space member:
   a. Size: 4 inches high by 3 inches deep, unless otherwise noted on Drawings.
   b. Fabricate with channel-shaped flanges at bottoms, and flange at top for engagement with bottom rails forming interlocking joints.
5. Corner gusset plates:
   a. Provide in each corner of sectional units.
   b. Floor mounted casework shall be equipped with leveling devices easily adjustable from within units, to compensate for unevenness in floor.
   c. Fabricate leveling socket as integral part of gusset plate.

d. Provide slot in each 1/2 inch leveling bolt for easy adjustment using screwdriver from above.
e. Provide access to leveling bolt through holes in cabinet bottoms directly above leveling bolts.
f. Provide access holes in cabinet bottoms with removable snap-on covers.

6. Doors:

a. Fabricate of double wall sound deadened construction. Place sound-deadening mineral filler between inner and outer pans for quiet operation.
b. Fabricate for fit with minimum clearance.
c. Fabricate inner door pans to be held securely in place by concealed fasteners that are easily removable for cleaning in case of spillage.
d. Where swinging doors are specified or shown, fabricate of double wall construction, glazed where specified.

7. Adjustable shelves in cabinets:

a. Fabricate with adjustable supports at 1/2 inch centers.
b. Support shelves on adjustable shelf clips, made of cadmium plated steel, engaging in slotted members so dust cannot accumulate at bottoms. Clips shall retain shelves to prevent accidental removal.
c. Provide 2 inch high lip at back of rear portion of shelf to prevent shelf contents from falling.

B. Base Cabinets:

1. Construct base cabinets to achieve industry standard height of 31 inches or 37 inches with a 1 inch countertop without raising cabinet off floor beyond height required for normal leveling conditions (1 inch nominal).
2. Removable access panel:
a. At cupboards and knee spaces.

C. Accessories:

1. Fasteners and Anchors: Size and type to securely fasten and anchor items to substrates and supporting structure.
2. Provide miscellaneous fillers and panels required for a finished installation.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. For General Installation Requirements, applicable to this and all other Casework Specification Sections including, but not limited to, examination, installation, adjusting, cleaning, and protection general requirements, refer to Specification Section 123553 - Laboratory Casework-General Requirements.

3.2 ADDITIONAL INSTALLATION REQUIREMENTS

A. Fasten together assemblies to meet Performance Requirements specified above.

B. Floor Mounted Cabinets:

1. Locate at designated positions.
2. Level by means of adjustment device located in cabinet's bottom corners.

3. Continuously seal space between base cabinet and floor with sanitary silicone specified in Division 7.

C. Countertops: Anchor to base cabinets.

D. Field Joints:

1. Reinforce and weld in manner equivalent to shop welds and joints.

E. Wall Joints:

1. Joints between equipment and walls up to 3/8 inches wide:
   a. Fill with sealant backing bond breaker rod and silicone sealant.
   b. Comply with requirements of Division 7.
   c. Apply sealant in one continuous pass, compressing surface slightly concave and forcing contact with both sides of joints.
2. Joints between casework and walls larger than 3/8 inches wide:
   a. Seal with stainless steel closure or filler strip.
   b. Fit tightly and fasten securely with concealed clips.

F. Site Tolerances: Install wall-to-wall countertops with a maximum 1/4 inch gap.

END OF SECTION 123554

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. This Section includes, but is not limited to, all materials, labor and equipment, complete with all anchors and related accessories, necessary to furnish, deliver and install:

1. Open-leg Tables Open-leg tables shall be steel framed with steel legs.
2. Aprons
3. Floor Mounted Base Cabinets (Swinging doors, drawers and open shelves)
4. Wall Mounted Cabinets
5. Full Height Cabinets
6. Island Bench Structural Modules
7. Adjustable Shelves
8. ADA Workstations
9. Fasteners, anchors and miscellaneous fillers and panels required for a finished installation.

B. Although such work is not specifically shown or specified, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.

C. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 018113, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

D. For general requirements, applicable to this and all other Casework Specification Sections including, but not limited to definitions, system description, submittals, LEED requirements, warranty, quality assurance, performance requirements, mock-up, testing, field measurements, pre-installation conference, delivery, storage and handling, project conditions, and sequencing requirements, refer to Specification Section 123553 - Laboratory Casework-General Requirements.

E. Products Installed But Not Specified Under This Section:

1. Section 115343 - Laboratory Service Fixtures: Supply of service fixtures for placement under this Section.

1.3 SUBMITTALS

A. LEED Submittals:

1. Environmental Materials Reporting Form (EMRF) Recycled Content (Credit MR 4). Provide the following information:

a. Name of Product and Manufacturer.

b. Material cost breakdowns. Cost breakdowns must include total material-only cost (excluding installation, labor and equipment).
c. The percentage (by weight) of post-consumer and pre-consumer recycled content in the submitted product(s), if applicable.

2. Environmental Materials Reporting Form (EMRF) FSC Wood. Include the following information:

a. Identify each permanently installed wood products, both FSC and non-FSC.
b. For all FSC-certified products indicate if the product is FSC Pure, FSC Mixed Credit, or FSC Mixed (XX)%.
c. Indicate material costs for all FSC products.

3. Environmental Materials Reporting Form (EMRF) - Composite Wood Products. Include the following information:

a. Confirmation that composite wood and Agrifiber products contain no added urea formaldehyde.
b. For each laminate adhesive used, documentation indicating that the adhesive contains no added urea formaldehyde.

4. VOC Reporting Form:

a. For all adhesives, sealants, coatings, and paints, applied onsite provide the VOC content in grams/Liter (g/L) less water and other exempt compounds.

PART 2 - PRODUCTS

2.1 GENERAL

A. For general requirements, applicable to this and all other Casework Specification Sections including, but not limited to, manufacturers, materials, components, and finish and performance requirements, refer to Specification Section 123553 - Laboratory Casework-General Requirements.

2.2 LEED REQUIREMENTS

A. Certified Wood: Interior architectural woodwork shall be produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."

B. Composite Wood and Agrifiber Products: All composite wood and agrifiber products shall contain no added urea formaldehyde. All laminating adhesives applied both on and off site shall contain no added urea formaldehyde.

C. Emissions: Products shall meet the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Give preference to products with recycled content.

E. All field-applied paints and coatings used within the building waterproofing envelope shall comply with Green Seal Standard GS-11, Paints, 1st Edition, May 20, 1993, Green Seal Standard GC-03, 2nd Edition, January 7, 1997, and South Coast Air Quality Management District (SCAQMD) Rule 1113, Architectural Coatings, rules in effect January 1, 2004.

F. All field-applied adhesives and sealants shall comply with the requirements of South Coast Air Quality Management District (SCAQMD) Rule #1168 effective date of July 1, 2005 and rule amendment date of January 7, 2005.

2.3 MANUFACTURERS

A. Casework Acceptable Manufacturers:

1. TMI Systems Design Corp., Dickenson, ND
2. Case Systems, Inc., Midland MI
3. Thermo Scientific, Austin, TX
4. Mott Manufacturing, Maxwelton, WV

B. Acceptable Manufacturers, High Pressure Chemical Resistant Plastic Laminate:

1. Wilsonart, Wilsonart International, Inc., Temple, TX (Chemsurf)
2. Nevamar, Nevamar Corp., Odenton, MD (Chemarmor) (NEVAMAR)
3. Formica, Formica Corp., Cincinati, OH (Formica)

C. Applicable Standards:

1. Chemical resistant laminate shall meet the surface requirements published in NEMA LD3 current edition for Type HGL.
2. It shall also meet performance standards of the following:
   a. ANSI (American National Standard Institute)
   b. Federal Specifications LP 508H
   c. NSF-35

D. Provide products meeting or exceeding SEFA 8 PL-2010 Recommended Practices for Plastic Laminate Laboratory Grade Furniture, Casework, Shelving and Tables, as established in the Scientific Equipment & Furniture Association (SEFA) 2010 Desk Reference, 4thEdition.

2.4 MATERIALS

A. AB equivalent plywood laminating panel with K-2 innerplys and chemical resistant laminate faces. 5-ply for 1/2 inch thickness, 7-ply for 3/4 inchCertified Particleboard: FCS Certified Chain of Custody, 100% pre-consumer recycled wood fiber particleboard with no Urea Formaldehyde added during the manufacturing process.

1. Up to 7/8 inch thick: Industrial Grade average 47-pound density meeting ANSI A 208.1-2009, M-2 requirements.
2. 1 inch think: Industrial Grade average 45-pound density meeting ANSI A 208.1-2009, M-2 requirements.

B. Certified Particleboard: SCS Certified 100% pre-consumer recycled wood fiber particleboard with no Urea Formaldehyde added during the manufacturing process.

1. Up to 7/8 inch thick: Industrial Grade average 47-pound density meeting ANSI A 208.1-2009, M-2 requirements.
2. 1 inch think: Industrial Grade average 45-pound density meeting ANSI A 208.1-2009, M-2 requirements.

C. Decorative Laminates: GREENGAURD Indoor Air Quality Certified

1. Chemical-Resistant decorative laminate (Chemsurf), NEMA Test LD 3-2005.
2. Laminate Color Selection: Maximum 1 color per unit face and 5 colors per project.

D. Edging Materials:

1. 1mm PVC banding, machine applied.
2. 3mm PVC banding, machine applied and machine profiled to 1/8 inch radius.

E. Glass:

1. Wall unit full sliding glass doors: 1/4 inch thick laminated safety glass.
2. Glass insert doors, hinged or sliding wall cabinets: 1/4 inch thick laminated safety glass.
3. Glass insert doors, hinged or sliding tall or base cabinets. 1/4 inch thick laminate safety glass.
4. Sliding doors mounted in aluminum track.

F. Trim glass inserts: Extruded rigid PVC channel and self-locking insert retainer strip

G. Suitable Sub-surfaces: Chemical resistant laminate shall be bonded to a core material such as plywood using adhesives and techniques as recommended by reliable adhesive manufacturers, and American National Standard Performance Standards for Vertical Surfaces: Chemical Resistant Plastic Laminate Facing Sheet NEMA LD-3. Vertical Grade, 0.028 inch at exposed and at semi-exposed surfaces.

H. Semi-Exposed Surfaces including open interiors and wall bottoms: Interior surfaces in open cabinets, behind doors, drawer boxes, backs, underside of wall bottoms, shelves and unfinished ends shall be laminated with a fused laminate that meets or exceeds the performance standards for NEMA LD-3. Melamine foil or polyester surfaced panels or other surface types that do not meet these requirements will not be acceptable

I. Color and Pattern at Exposed Surfaces: As selected by Architect from Manufacturer's standard. Wood grain direction shall be vertical on doors, end panels, drawer fronts, aprons, and exposed backs.

J. Edging Material: Poly-Vinyl Chloride (PVC), 0.12 inches.
   a. Edge color for fixed shelves, spreaders, and shelves in open or glazed door cabinets shall match the cabinet box front edge color. Edge color for adjustable shelves behind solid doors shall match the cabinet interior color.
   b. Color, Shape, and Pattern: As selected by Architect from Manufacturer's standard.
2. Core: Plywood.
   a. Thickness:
      1) Panel Structural Components: Minimum 3/4 inch thick.
      2) Back Panels, Drawer Components, and Drawer Bottoms: Minimum 1/2 inch thick.
      3) Fixed Shelves, Dividers, Mounting Stretchers: Minimum 3/4 inch thick.
      4) Adjustable shelves in open cabinets and shelves in cabinets: Minimum 1 inch thick.

2.5 ACCESSORIES

A. Fasteners: Size and type to suit application.

B. Adhesive: PVA or type recommended by casework fabricator to suit application.
1. Adhesive: Water-based, formaldehyde free, maximum of 20 g/L VOC content.

2.6 FABRICATION

A. General Requirements:

1. Prior to fabrication, field measure actual existing conditions to ensure proper fit.
2. General: Comply with AWI Section 1600-S-9.
3. Material shall be selected so that the finished installation shall provide an attractive and harmonious appearance. All exterior casework surfaces exposed to view after installation, and cabinet interior surfaces exposed to view when doors and drawers are in the open position, shall be chemical resistant plastic laminate. All plywood shall be hardwood plywood certified by the manufacturer to be produced with No Added Formaldehyde (NAF). All woods shall be obtained from forests certified by an FSC accredited certification body to comply with FSC STD-01-001, “FSC Principles and Criteria for Forest Stewardship.” Chain-of-custody documentation shall be provided in accordance with FSC’s standards. Manufacturer shall provide certification and include statement indicating cost for each certified wood product. Softwoods such as Fir or Pine are not permitted.
4. Plastic laminate exposed to view after completion of installation shall be of color selected by the Architect from Manufacturer’s standard color and in conformance with the normally accepted standards required of the Scientific Laboratory Equipment Industry.
5. The cabinets shall be full overlay construction with 3/4” thick door and drawer fronts. The exposed face of doors and drawer heads shall be chemical resistant plastic laminate bonded to particle board. The door and drawer heads shall occupy a plane extending 3/4" past the plane of the front of the cabinet body, shall be square edged, and shall overlay the face of the cabinet leaving minimal reveals. All cabinet end panels shall be finished for the purpose of future relocation.

B. Panels: Laminate panels used at doors, cabinet walls, shelves, drawer front, backs, and other applications with adhesive and high pressure system using heat for thermally fused construction resulting in continuous contact and rigid glue line.

C. Backs: Fabricate backs of plastic laminate faced panels with plastic laminate at conditions with exposed or semi-exposed surfaces or with plastic laminate backing sheets at concealed surfaces to establish balanced construction.

D. Edges: Exposed edges, including at cabinets, doors, shelves, drawer front: PVC applied with hot melt adhesive. At PVC edges of adjustable shelves, match interior surface of plastic laminate faced cabinet.

E. Base and Toe Space: Separate toe base shall be constructed from AC plywood factory assembled and installed on base cabinet.

F. Joinery: Secure cabinet panels together with concealed dowels or with concealed interlocking mechanical fasteners. Joinery Methods and Materials: Comply with AWI Quality Standards, Section 1600-S-11. Interlocking Mechanical Fasteners: Designed for joining plywood panels, including panels with plastic laminate facing, only.

G. Open-leg Tables:
Tables shall consist of steel frame with welded steel legs.

H. Aprons:
All apron rails shall be 3/4" thick 5-ply lumber core plywood with chemical resistant plastic laminate veneer.

I. Floor Mounted Base Cabinets:

1. Panels and Rails:
   a. All cabinet end panels shall be 3/4" thick chemical resistant plastic laminate veneer core plywood with 1 mm PVC edge.
   b. Bottom panels and toe space rails shall be 3/4" thick chemical resistant plastic laminate veneer core plywood with 1 mm PVC on exposed edges.
   c. Top panels shall be 1" thick chemical resistant plastic laminate veneer core plywood with 1 mm PVC on exposed edges.
   d. End panels shall be multiple doweled, glued, and screwed to top panel, bottom panel and toe space rail.
   e. Cupboard base cabinet shelves shall be full-width adjustable, 3/4" thick plastic laminate veneer core plywood with 1 mm PVC on exposed edges. Shelves shall be adjustable on 32 mm centers utilizing shelf support clips.
   f. Sink cabinets shall be made without a top panel.
2. Backs:
   Cabinet backs shall be 1/4" thick hardboard with plastic laminate facing sheet, dadoed into end panels and securely fastened to cabinet bottom and top panels. Backs that are attached to end panels with cleats shall be unacceptable. Removable backs shall be provided at all cupboard base cabinets. Base Cabinets with drawers shall have full backs.
3. Intermediate Rails:
   Intermediate rails shall be 3-1/4" x 3/4" veneer core plywood with plastic laminate facing sheet on exposed edges. Rails shall be screwed to end panels. Intermediate rails shall be mounted at the front between the drawers and between all drawers and doors.
4. Drawers:
   Drawer sides shall be 7/16" thick, 7-ply solid Birch veneer plywood. Drawer heads shall be 3/4" thick, 3-ply solid core plywood with chemical resistant plastic laminate and 3 mm PVC edging. A glue and dove-tailed joint shall be used to attach the drawer head to the sides on all drawers over 3" in depth. A mortise and tenon joint shall be used for shallow drawers. Drawer bottoms shall be 1/4" thick tempered hardboard with SEFA 8 chemical resistant clear finish, set and glued into 1/4" grooves, four sides.

5. Doors:
   Doors shall be particle board with chemical resistant plastic laminate facing sheet and with 3 mm PVC edging, mounted on cabinet with 1 pair of offset hinges and shall be latched with a roller catch. Double doors shall have a roller catch on each door. Each door shall have one pull mounted vertically. Locks, when required on double doors, shall be mounted on the right-hand door.

J. Wall Hung Cabinets:

1. All cabinet end panels shall be 3/4" thick plastic laminate veneer core plywood with 1/8" plastic laminate facing on front edges. Tops and bottoms shall be 1" thick plastic laminate veneer core plywood with 1/8” plastic laminate facing on exposed edges, multiple doweled into end panels, and secured with glue and countersunk screws. Shelves shall be full-width adjustable, 3/4" thick plastic laminate veneer core plywood with 1/8" thick plastic laminate facing on exposed edge. Shelves shall be adjustable on 32 mm centers utilizing shelf support clips. The backs shall be 3/8" plastic laminate veneer core plywood.
2. Doors:
   a. Sliding Plate Glass Doors:
      Solid glass doors shall be 1/4" thick safety glass with polished edges. Doors shall be set in an aluminum bottom frame containing roller bearings and held in position with an aluminum guide at the top of the case.
   b. Swinging Doors:
      Cabinets shall be designed and integrally constructed for full enclosure to assure dust proofing of the cabinet interior.

Doors shall either be solid hardwood core panel or glass framed, as indicated. Solid hardwood core doors shall be 3/4", plastic laminate on plywood with 1/8" plastic laminate edging. Glass doors shall be 1/4" thick safety glass with polished edges.

Doors shall be hung on 1 pair of offset hinges and shall latch with a roller catch. Double doors without locks shall have a roller catch on each door. Double doors with locks shall have an elbow catch and a roller catch mounted on the right-hand door. Glass shall be set indo door solid wood frame and secured with a plastic retainer.

K. Full Height Cabinets:

1. Cabinet:
   a. Cabinets shall be designed and integrally constructed for full enclosure to assure dust proofing of the case interior.
   b. All cabinet end panels shall be 3/4" thick plastic laminate on plywood with 1/8" plastic laminate facing on exposed vertical edges and bottom horizontal edge. Tops shall be 1" thick plastic laminate on plywood with 1/8" plastic laminate facing on exposed edge, multiple doweled into end panels, secured with glue and countersunk screws.
   c. Shelves shall be full-width adjustable, 1" thick plastic laminate on plywood with 1/8" thick plastic laminate facing on exposed edge. Adjustable shelves shall be adjustable on 32mm centers utilizing shelf support clips. To assure a completely rigid case, a fixed center shelf of 1" thick plastic laminate veneer core plywood with 1/8" plastic laminate facing on exposed edge, shall be multiple doweled into end panels, secured with glue and countersunk screws.
   d. Cabinet bottoms shall be 3/4" thick plastic laminate veneer plywood, multiple doweled and glued securely to end panels. All cabinets 22" in depth shall have a 3/4" x 3-3/4" plywood toe space rail to form a 4" high toe space. Cabinets 16" deep shall use a 1" x 4-1/2" plastic laminate veneer plywood base rail mounted flush with the face of the cabinet. The backs in full height cabinets shall be 3/8" plastic laminate veneer core plywood. Cabinet interior shall be flush.
2. Doors:
   a. Doors shall either be solid hardwood core panel, glass framed, screen framed or with marker board, as indicated.
   b. Doors shall be 3/4", plastic laminate faced plywood with 1/8" plastic laminate edging. Each door shall have one pull mounted vertically, shall be hung on 1-1/2 pair of offset hinges, and shall latch with a roller catch. Double doors without locks shall have a roller catch on each door. Double doors with locks shall have an elbow catch and the lock and a roller catch mounted on the right-hand door.
   c. Glass framed doors shall be 3/4" thick with 1" thick by 3-3/16" wide solid wood with plastic laminate framing, mortised, tenoned, and glued. Glass shall be set into door frame and secured with a plastic retainer.
   d. Screen framed doors shall be black aluminum wire mesh with protective finish to prevent corrosion.
   e. Marker board doors shall be 3/4", plastic laminate veneer plywood with 1/8" plastic laminate edging. A dry-erase magnetic white board shall be applied to the door.

L. Island Bench Structural Modules:

1. Island Structural Modules shall be made from cold-rolled steel with a corrosion and chemical resistant finish as specified in 123553.
2. Structure Modules shall provide support structure.
3. The structural modules shall be capable of supporting adjustable shelving on each side.

4. Single or double-slotted uprights shall have holes on 1 inch centers for adjustable shelves.

M. Adjustable Shelves:

1. Adjustable module shelving shall attach to the structural module upright, or to the wall mounted rails, with height adjustability on 1 inch increments.
2. Adjustable module shelves shall be supported by 11 gauge brackets, which shall mount to the single or double-slotted support module upright. Shelf brackets shall be mounted above or below the shelves as shown on drawings.
3. Outer and Inner shelves shall be 1" thick plastic laminate faced hardwood plywood on all exposed surfaces.
4. Top outer shelves shall fit flush with top ledge of panel or core. Top surface of pane or core shall act as inner shelf.
5. End lips shall be provided.
6. Inner shelves shall be added to back of outer shelves to fill the space between island uprights.

N. Wall Mounted Shelving System:

1. Wall Mounted Shelving Systems shall consist of plastic laminate faces wood helves, with Heavy Duty Vertical Wall Standards, and Heavy Duty Adjustable Shelf Brackets. Fasten standards to concrete masonry walls or properly blocked steel studded walls with appropriate flat head screws.
2. Vertical Wall Standards shall allow adjustable bracket to be positioned along its full length for maximum use of space. A pair of vertical supports shall hold the shelves and their support brackets.
3. Adjustable shelf bracket shall have up-turned lip to prevent shelves from being pulled off bracket. It shall be formed from high-strength, cold-rolled steel. It shall include mounting hardware to secure bracket to vertical wall standards.

2.7 MOBILE ADA WORKSTATION

A. Kewaunee (Model #T05H3760-0 ADA Workstation) or approved equal

1. Handicapped accessible, with four inch swivel casters, two of them equipped with brakes.
2. It shall be built of plastic laminate face sheet and plywood.
3. Complete with Epoxy Resin Countertop.
4. Size: 30” Deep by 60” Long by 30”-37” adjustable height on 1” increments.
5. Cabinet: Two drawer cabinet
6. Sink: 9” Diameter – Stainless Steel
7. 1 ½” I.P.S. Stainless Steel Sink Outlet
8. 6ft. Long 1” dia. Stainless Steel Braided Drain line Hose with Quick-Disconnect hose fittings.
9. Electric Fixtures: 120 VAC GFI Duplex Pedestal (Kewaunee Model # 0656-02)
10. 8 ft long extension cord
11. Fittings:

    a. Cold and Hot Water w/4” Wrist Blade Handles.
    b. 4ft. long ½” dia Reinforced PVC Cold and Hot Water Service Hoses with Quick-Disconnect. Color coded per services.
    c. Single Outlet Service Fittings.
    d. 4ft. long 3/8” dia Reinforced PVC Gas/Air/Vac Service Hose with Quick-Disconnect Hose Fittings. Color coded per services.

2.8 ACCESSORIES

A. Fasteners and Anchors: Size and type to securely fasten and anchor items to substrates and supporting structure.

B. Provide miscellaneous fillers and panels required for a finished installation.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. For General Installation Requirements, applicable to this and all other Casework Specification Sections including, but not limited to, examination, installation, adjusting, cleaning, and protection requirements, refer to Specification Section 123553 for Laboratory Casework - General Requirements.

B. Site Verification of Conditions: Verify that temperature and humidity at site comply with manufacturers written requirements.

C. Verify that blocking is in place before beginning work.

D. Verify that field measurements are as shown on shop drawings.

E. Verify that mechanical, electrical, and other items affecting work of this section are in place and ready to receive the work.

3.2 ADDITIONAL INSTALLATION REQUIREMENTS

A. Floor Mounted Cabinets:

1. Locate at designated positions
2. Level by means of wood shimming.
3. Continuously seal space between base cabinet and floor with sanitary silicone specified in Division 7.

B. Countertops: Anchor to base cabinets, unless noted otherwise.

C. Fasten together assemblies listed below with devices of adequate strength to support cabinet and shelves loaded 40 pound per linear foot per shelf for enclosed wall cabinets or open adjustable shelves not inclusive of cabinet, shelf, and bracket weight.
1. Wall cabinet to wall.

D. Install in accordance with AWI Architectural Woodwork Quality Standards, Section 1700.

E. Shim as required using concealed shims.

F. Before making cut-outs, drill pilot holes at corners.

G. Tolerances for Field Assemblies and Joined Items:

1. Maximum Variation from True Position: 1/16 inch unless otherwise specified or required by AWI grade.

2. Maximum Offset from True Alignment with Abutting Materials: 1/32 inch unless otherwise specified or required by AWI grade.

H. Setting and Securing Casework and Components. Use joint fasteners to align and secure adjoining cabinets and countertops.

I. Secure to anchors, built-in blocking, or directly attach to substrates where capable of adequately supporting load. Use toggle bolt type fasteners for wall mounted components. Secure countertops to base cabinets.

J. Install hardware in accordance with manufacturer's recommendations. Adjust and leave in proper working order.

K. Site Tolerances: Install wall-to-wall countertops with a maximum 1/4 inch gap.

END OF SECTION 123555

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. The provisions of the Contract Documents apply to the work of this section.

B. This Section includes, but is not limited to, all materials, labor and equipment, complete with all anchors and related accessories, necessary to furnish, deliver and install:

1. Floor Mounted Base Cabinets (Swinging doors, drawers and open shelves)
2. Wall Hung Swinging Door Cabinets
3. Adjustable Shelves
4. Miscellaneous fillers and panels required for a finished installation.

C. Although such work is not specifically shown or specified, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.

D. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 018113, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

E. For general requirements applicable to this section including, but not limited to definitions, system description, submittals, quality assurance, mock-up, testing, field measurements, pre-installation conference, delivery, storage and handling, project conditions, and sequencing requirements, refer to Specification Section 123400 for Laboratory Casework - General Requirements.

PART 2 - PRODUCTS

2.1 GENERAL

A. For general requirements, applicable to this and all other Casework Specification Sections including, but not limited to, manufacturers, materials, components, and finish and performance requirements, refer to Specification Section 123553 - LABORATORY CASEWORK-GENERAL REQUIREMENTS.

2.2 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. NuAire, Plymouth, MN
2. TFI/Inline Design Corp., Commerce City, CO

3. Terra Universal, Inc., Fullerton, CA
4. LOC Scientific, Inc., Buford, GA

2.3 FABRICATION

A. Prior to fabrication, field measure actual existing conditions to ensure proper fit.

B. Casework shall be of sealed and solid seamed welded polypropylene construction, including casework, countertops, sinks and accessories.

C. Polypropylene shall be a high corrosion resistant material that has high temperature and tensile strength. It shall possess excellent chemical resistance to organic solvents and degreasing agents as well as electrolytic attack. The properties of polypropylene shall be enhanced with anti-oxidizing agents and UV stabilizers to increase strength and improve thermal characteristics. Polypropylene shall be light weight, stain resistant and have a low moisture absorption rate.

D. Polypropylene casework shall be manufactured from ¼", 3/8" and ½" stress relieved, refrigerator white standard polypropylene.

E. Each casework unit shall be machined from a full length sheet of polypropylene, designed to be folded into an unbroken surface and seamless exterior (except one rear corner). All interior surfaces shall be completely seam welded and reinforced, where necessary, forming a completely rigid and self-supporting cabinet that can be used interchangeably in a group of casework or can be used as a stand-alone cabinet. When properly installed, the casework shall provide an easily cleaned, smooth and flush interior and a dust resistant installation.

F. Drawer and door pulls shall be constructed from polypropylene, which offer a comfortable hand grip, through-bolt attachment to the upper middle of drawer/door fronts, with polypropylene fasteners from the back face. Two pulls shall be provided on drawers wider than 24 inches.

G. Doors shall be solid one-piece construction and of overlapping design. Hinges shall be molded from refrigerator white polypropylene, with a minimum of three-knuckle rounded edge barrel. A minimum of two hinges shall be provided for doors under 36 inches wide. Each hinge shall be attached to the door and frame with two polypropylene screws on each side. Door catches shall consist of 20-mil polyethylene coated magnets that are imbedded into the door/frame at the top and bottom of each door. The catches shall provide a minimum pull of seven pounds. Where adjustable shelves are required in base cabinets or cupboards, the precision PVC adjustment clips shall allow you to adjust shelf positions on ½" increments.

H. Drawer guides (on each side) shall provide quiet, smooth and precise operation with little or no side-to-side motion when withdrawing the drawer. The drawers shall be constructed from ½ inch polypropylene, through-out, in the same "V" groove, fold-up fashion as the base cabinets, providing a seamless exterior. The drawer fronts shall be a separately welded piece. All drawers shall have integral draw stops to prevent inadvertent drawer removal and contact with the back of the cabinet, yet allow easy removal without the use of tools.

I. The standard method of leveling the base cabinets to the floor, shall utilize polypropylene shims. It should be recognized that ALL POPYPROPYLENE CONSTRUCTED PRODUCTS because of their flexible nature do not lend themselves to field adjustment procedures that permit door/drawer adjustments. Field adjustability is minimal, therefore proper leveling of casework at the time of installation is critical. Leveling devices in base cabinets shall be provided in each corner of the base cabinet. The leveling one inch thick threaded polypropylene rods shall be adjusted from within the cabinet's interior and provide for a one inch adjustment.

The levelers shall be protected by a ½ inch lip with cover around the leveler to control spill leakage under the cabinet.

J. Base cabinets shall be configured with a removable access panel in the rear for access to a plumbing utility chase. Panels shall be ¼ inch thick polypropylene mounted flush within the rear wall's ½ inch thick polypropylene. Polypropylene screws shall fasten the panel to the rear wall. All base cabinets shall have a 4 inch high by 3 inch deep toe-kick.

K. All base cabinets shall have a full length 3 inch gusset on both the front and rear top for fastening the countertop and/or fume hoods. Each base cabinet shall also have a ½ inch spill lip at the front floor to contain liquids.

L. Vented Storage Construction

1. The sides, back, top, bottom, front frame and doors of vented storage cases shall be constructed from ½-inch polypropylene.
2. Storage cases shall provide for ventilation of the interior. A 1-½ inch NPT threaded (vent) connection shall be welded to the top in each rear corner. Each shelf shall have both a ½-inch space between the front and back walls except where required for support pegs and a 1-inch downward return on all sides for liquid retention. Shelves shall be adjustable on 2-inch centers via molded polypropylene pegs. 6-inches from the bottom of doors, a series of 1-inch diameter holes on 2-inches centers shall permit the flow of air into the case and shall be adjustable by an equivalent offsetting set of holes on the inside of the door.
3. Each cabinet shall be vented into the fume hood with a 1-1/2 inch vent pipe. Providing a positive airflow directly into the fume hood exhaust system.
4. Vented base storage cases shall have 1½-inch diameter adjustable levelers that are accessible via a 9/16-inch square-head ratchet, from inside on the cabinet's floor and protected from spills with a ½-inch high rim, covered with a removable cap. A minimum of two (front and rear) levelers shall be provided for each 24-inch section of floor space. The levelers shall thread through a minimum of 1½-inches of material for stability and permit an adjustment of 2-inches.

M. Countertops shall be 1" thick solid polypropylene with a pebble finish to resist scratching and shall be custom sized, as shown on drawings. Integral polypropylene sink incorporated shall be provided.

N. All non-plastic internal surfaces and/or components shall be corrosion, flame, and moisture resistant. They shall not deteriorate when exposed to liquid or vapor phase decontaminants, such as formaldehyde, alcohol, iodophors, peracetic acid, halogenated phenols, and hypochlorite solutions.

O. Fasteners and Anchors: Size and type to securely fasten and anchor items to substrates and supporting structure.

P. Provide miscellaneous fillers and panels required for a finished installation.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. For General Installation Requirements, applicable to this and all other Casework Specification Sections including, but not limited to, examination, installation, adjusting, cleaning, and

protection requirements, refer to Specification Section 1234553 for Laboratory Casework - General Requirements.

3.2 DELIVERY, STORAGE AND HANDLING

A. Do not deliver or install equipment until the following conditions have been met:

1. Windows and doors are installed and the building is secure and weather tight. The space should be heated to at least 40°F.
2. Ceiling, overhead ductwork, and lighting are installed.
3. All painting is completed and floor finish is installed.

B. Polypropylene casework and related materials require the interior building temperature not to exceed 90°F to avoid undue structural fatigue and damage.

C. Protect finished surfaces from soiling or damage during handling and installation. The equipment comes with a protective film that should be left in place while handling, and then removed ONLY where pieces are mated during installation.

D. When ambient temperatures are below -20°F, careful handling is required to prevent polypropylene from cracking at the seams.

3.3 ADDITIONAL INSTALLATION REQUIREMENTS

A. Site Verification of Conditions:

1. Verify that field measurements are as shown on shop drawings.
2. Verify that mechanical, electrical, and other items affecting work of this section are in place and ready to receive the work.

B. Interface with Other Work. Install items in a sequence to not delay:

1. Adjoining construction.
2. Connections of casework and hoods to mechanical and electrical services.

C. Install hardware in accordance with manufacturer's recommendations. Adjust and leave in proper working order.

END OF SECTION 123557

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Roll-up aluminum-tread rail floor mats with aluminum hinges.
2. Loop filament matting.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 03 30 00 - CAST-IN-PLACE CONCRETE for concrete work, including forming, placing, and finishing concrete floor slabs, and for concrete materials for grouting and filling around and under recessed mats and frames.

1.3 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Show the following:

1. Items penetrating floor mats and frames, including door control devices.
2. Divisions between mat sections.
3. Perimeter floor moldings.

C. Samples for Initial Selection: For each type of product indicated.

1. Floor Mat: 12-inch- square, assembled sections of floor mat.
2. Frame Members: 12-inch- long Sample of each type and color.

D. Maintenance Data: For floor mat and frames to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain floor mats and frames through one source from a single manufacturer.

B. Accessibility Requirements: Provide installed floor mats that comply with Section 4.5 in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)".

1.5 PROJECT CONDITIONS

A. Field Measurements: Indicate measurements on Shop Drawings.

1.6 COORDINATION

A. Coordinate size and location of recesses in concrete with installation of finish floors to receive floor mats and frames.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Roll-up Aluminum Rail Hinged Mats (WOM-1):

a. AFCO-USA.
b. Balco, Inc.
c. C/S Group.
d. Mats Incorporated.
e. Musson, R. C. Rubber Co. (The).

2. Loop Filament Matting (WOM-2):

a. AFCO-USA.
b. Mats Incorporated.
c. Mohawk Group.
d. Tennessee Mat Company, Inc.

B. Basis-of-Design (WOM-1): Pedimat AA by C/S Group

C. Basis-of-Design (WOM-2): Mohawk Group,Step Up - DD 763, Mineral 508

2.2 METAL FRAME MATERIALS

A. Extruded Aluminum: ASTM B 221 alloy 6061-T6 or alloy 6063-T5, T6, or T52 as standard with manufacturer.

2.3 CONCRETE FILL AND GROUT MATERIALS

A. Provide concrete materials complying with Section 03 30 00 - CAST-IN-PLACE CONCRETE for grout and fill around and under recessed mats and frames that produce concrete equivalent in strength to cast-in-place concrete slabs. For concrete fill, adjust aggregate size to not exceed one-third fill thickness.

2.4 FLOOR MATS

A. General: Provide colors, patterns, and profiles of materials, including metals and metal finishes indicated or specified. If not indicated, provide colors, patterns, and profiles selected by Architect from manufacturer's standards.

B. Roll-up Aluminum Rail Hinged Mats: Clear-anodized finish, extruded-aluminum tread rails sitting on continuous vinyl cushions with 1-1/2-inch-wide by 3/8-inch-thick, tread rail modules. Provide aluminum hinges and 28-oz./sq. yd. weight, level-cut, nylon-pile, fusion-bonded carpet tread inserts].

1. Tapered Rigid Frame: Tapered extruded-aluminum frame members, not less than 1-1/2 inches wide, with mitered corners and finish to match tread-slat extrusions.

C. Loop Filament Matting: 3M's "Nomad" loop filament vinyl material 3/8 inch thick, with solid vinyl sheet backing and built-in chemical agents to reduce fungus and mildew. Provide color specified or scheduled or, if not specified or scheduled, as selected by Architect.

1. Flexible Edging: 2-inch-minimum, vinyl edge strip in matching color, bonded to each end of mat material or backing sheet.

2.5 FABRICATION

A. General: Where possible, verify sizes by field measurement before shop fabrication.

B. Floor Mats: Shop fabricate units to greatest extent possible in sizes as indicated. If not otherwise indicated, provide single unit for each mat installation; do not exceed manufacturer's recommended maximum sizes for units that are removed for maintenance and cleaning. Where joints in mats are necessary, space symmetrically and away from normal traffic lanes. Miter corner joints in framing elements with hairline joints or provide prefabricated corner units without joints.

C. Recessed Metal Mat Frames: Extruded aluminum of size and style to fit floor mat type specified, for permanent recessed installation, complete with corner pins or reinforcement and anchorage devices.

1. Fabricate edge-frame members in single lengths or, where frame dimensions exceed maximum available lengths, provide minimum number of pieces possible, with hairline joints equally spaced and pieces spliced together by straight connecting pins.

D. With manufacturer's standard protective coating, coat surfaces of aluminum frames that will contact cementitious material.

2.6 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

2.7 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 611.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrate for compliance with requirements for location, sizes, minimum recess depth, and other conditions affecting installation of floor mats and frames.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install recessed mat frames to comply with manufacturer's written instructions. Set mat tops at height recommended by manufacturer for most effective cleaning action; coordinate top of mat surfaces with bottom of doors that swing across mats to provide clearance between door and mat.

1. Install necessary shims, spacers, and anchorages for proper location and secure attachment of frames.
2. Install grout and fill around frames and, if required to set mat tops at proper elevations, in recesses under mats. Finish grout and fill smooth and level.

3.3 PROTECTION

A. After completing frame installation and concrete work, provide temporary filler of plywood or fiberboard in recesses and cover frames with plywood protective flooring. Maintain protection until construction traffic has ended and Project is near Substantial Completion.

B. Defer installation of floor mats until Project is near Substantial Completion.

END OF SECTION 12 48 10

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Benches.
2. Bicycle racks.
3. Trash receptacles.
4. Pipe Bollards.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIRMENTS for certification level and certification requirements.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. LEED Submittals:

1. Product Data for Credit MR 4.1 and Credit MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.

C. Samples: For each exposed product and for each color and texture specified.

D. Samples for Initial Selection:

1. For units with factory-applied finishes.

PART 2 - PRODUCTS

2.1 BENCHES

A. Campus Standard: Plaza Series Model PL-5 Bench manufactured by FairWeather Site Furnishings.

B. Description: cast iron end frames and 1.5 inch wide steel straps at seat and back. Color: Gloss black.

C. Length: 72 inches.

2.2 BICYCLE RACKS

A. Campus Standard: Model BR-6 Bike Rack manufactured by FairWeather Site Furnishings.

B. Description: Circular-style “stall” separations with 3-1/2 inch diameter schedule 40 steel posts for surface mounting. Hot dip galvanized prior to powder coat paint finish. Color: Gloss black

C. Length: 122 inches.

2.3 LITTER RECEPTACLES

A. Campus Standard: Scarborough Litter Receptacle manufactured by Landscape Forms.

B. Description: 1.5 inch wide vertical straps at sides, with side openings and liner. Color: Grotto.

C. Options: Ash pan insert.

2.4 PIPE ANCHOR BOLTS

A. Chemical Anchor Bolts, stainless steel. 3/8-inch diameter by length as required to provide specified embedment.

2.5 BOLLARDS

A. Schedule 40 galvanized standard-weight steel pipe complying with ASTM A 53/A 53M, or electric-resistance-welded pipe complying with ASTM A 135/A 135M.

1. Pipe OD: Not less than 6-5/8 inches.
2. Installation Method: Cast in concrete.
3. Steel Finish: Galvanized.

B. Bollard Covers:

1. Molded high-density polyethylene pipe bollard sleeves, 1/8-inch thick, UV-stabilized, and including anti-static additives.
2. Color: Safety yellow.

2.6 CONCRETE

A. Connecticut Department of Transportation Standard Specifications for Roads, Bridges, and Incidental Construction Form 816-2004 Section M.03: Class C or better.

2.7 FABRICATION

A. Metal Components: Form to required shapes and sizes with true, consistent curves, lines, and angles. Separate metals from dissimilar materials to prevent electrolytic action.

B. Welded Connections: Weld connections continuously. Weld solid members with full-length, full-penetration welds and hollow members with full-circumference welds. At exposed connections, finish surfaces smooth and blended so no roughness or unevenness shows after finishing and welded surface matches contours of adjoining surfaces.

C. Pipes and Tubes: Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of handrail and railing components.

D. Exposed Surfaces: Polished, sanded, or otherwise finished; all surfaces smooth, free of burrs, barbs, splinters, and sharpness; all edges and ends rolled, rounded, or capped.

E. Factory Assembly: Assemble components in the factory to greatest extent possible to minimize field assembly. Clearly mark units for assembly in the field.

2.8 GENERAL FINISH REQUIREMENTS

A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.9 STEEL AND GALVANIZED-STEEL FINISHES

A. Baked-Enamel, Powder-Coat Finish: Manufacturer's standard, baked, polyester, powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for correct and level finished grade, mounting surfaces, installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Comply with manufacturer's written installation instructions unless more stringent requirements are indicated. Complete field assembly of site furnishings where required.

B. Unless otherwise indicated, install site furnishings after landscaping and paving have been completed.

C. Install site furnishings level, plumb, true, and securely anchored at locations indicated on Drawings.

1. Anchor benches, bicycle racks, and litter receptacles in accordance with manufacturer's instructions using holes provided. Level using stainless steel spacers to prevent rocking.

a. Installations into Concrete Sidewalks: provide 3-inches minimum embedment.
b. Installations into Brick Pavers: provide 3-inches minimum embedment into the concrete base (6-inches total embedment.)

D. Setting: Set cast-in bollards in concrete footing with smooth top, shaped to shed water. Protect portion of bollards above footing from concrete splatter. Verify that bollards are set plumb or at correct angle and are aligned and at correct height and spacing. Hold posts in position during placement and finishing operations until concrete is sufficiently cured.

END OF SECTION 12 93 00

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. This Section includes, but is not limited to, all materials, labor and equipment, complete with all anchors and related accessory, necessary to furnish, deliver and install:

1. +4°C Walk-in Cold Rooms

B. Although such work is not specifically shown or specified, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.

C. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 018113, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

D. Related Sections:

1. Division 22 - Plumbing: Fire protection and plumbing piping.
2. Division 26 - Electrical: Conduit and wiring to points of connection in junction box on exterior of controlled environment rooms.

1.3 SYSTEM DESCRIPTION

A. Design Requirements:

1. Manufacturer is responsible for engineering cooling system, including but not limited to selecting the controls and sizing the equipment, to meet the performance requirements.
2. Door-opening temperature recovery period: Following a 15 second door opening, the room temperature shall recover within 3 minutes.
3. Manufacturer is responsible for designing units, including refrigeration system, anchorage to structural system and necessary modifications to meet specified requirements, and shall maintain visual design concepts.
4. Drawings are diagrammatic and are intended to establish basic dimension of units, sight lines, and profiles of units.
5. The walk-in room contractor is responsible for physically measuring the area to assure that their equipment will fit in the designated location. Any dimensional corrections will be accomplished at no change in contract sum.
6. Provide concealed fastening whenever possible.
7. Attachment considerations: Account for site peculiarities and expansion and contraction movements so there is no possibility of loosening, weakening and fracturing connection between piping and units.
8. Modular constructed room incorporating wall, roof-ceiling, and floor panels.
9. Panels consisting of interior and exterior metal skins with an insulation core.

10. Incorporate integral mechanical method of fastening and sealing joints between panels to provide vapor-tight seal.
11. Allow for disassembly for possible relocation or expansion at a later date.
12. Prefabricated, metal clad, sectionally constructed and designed for easy and accurate field assembly and interchanging.
13. Provide unit complete with electrical devices such as receptacles, boxes, conduit, wiring, light fixtures, switches, surface mounted wiremold with duplex 120 Volts, 20 Amp receptacles, Tel/data outlets, power and control wiring, and power and control mechanisms, terminated at a single point on exterior of controlled environment rooms, for each voltage for connection to power supply. All materials in accordance with Division 26 – Electrical.
14. Standards:
    a. The controlled environment room design and installation shall conform to ADA and all other applicable codes, ordinances and regulations.
    b. Control panel shall be tested and certified by a Nationally Recognized Testing Laboratory to be constructed and documented in accordance with UL 508 and NFPA 79 (Electrical Standard for Industrial Machinery).
15. Refrigeration system:
    a. Size refrigeration piping integral with equipment.
    b. Size refrigerant pipe lines for distance between evaporator and condensing units.
    c. Provide interconnecting piping, including piping insulation. Provide piping and insulation materials per refrigeration equipment manufacturer's recommendations. Coordinate with other trades.
16. Electric power requirements:
    a. Single connection at Control Panel/Disconnect 208V – Three Phase - 60Hz, 20 Amp circuit to power auxiliaries such as, lights, heaters, controls, etc.
    b. Single connection at Condensing Unit 208V – 3 Phase - 60Hz, 20Amps (A fused Disconnect shall be provided within 6 feet of Condensing Unit).
    c. Provide wiring between evaporator and condenser unit as required for unit controls.
    d. All electrical materials shall be in accordance with Division 16 – Electrical.
17. Noise Control-Decibel Level:
    a. The noise level in the environmental enclosure during steady state control conditions shall fall below an NC-65 curve over the audible frequency range as measured by standard ASA methods, when the external ambient is 85 decibels or less.
18. Drain:
    a. 3/4” NPT Hook Up, 1-1/2”dia. Open Air floor drain for condensate.
19. Performance Requirements:
    a. Refrigeration system:
        1) Provide continuous operation at the setpoint conditions and within the specified tolerances with the following heat loads present in any combination:
            a) 10 watts/sq.ft. from receptacles
            b) Lighting on
            c) Personnel present in room and door openings as indicated
            d) Make-up air as scheduled
            e) Ambient conditions +24°C / 50% RH
            f) Compressor located in + 40°C ambient
        2) Provide equipment and controls for evaporator defrost cycle as required.
        3) Achieve and maintain individual room operating temperature requirements and performance.

20. Fire Resistance Requirements:

    a. Panel insulation flame spread: ASTM E84; 25 or less.
    b. Panels to have Class I rating when tested in accordance with FM 4880.
21. Structural Requirements:

    a. Design and fabricate wall panels to support roof-ceiling panels.
    b. Design and fabricate roof-ceiling panels to support roof and ceiling mounted equipment, and service technician.
22. Thermal Requirements:

    a. Refer to Schedule Article for initial temperature setting.
    b. Maximum temperature variation from setting: +/-1°C at any point in the room.

B. Interface with Adjacent Systems. The following items are incidental to this Section and provided by other Specification Sections:

1. Division 22:

    a. Sprinkler piping.
    b. Condenser water supply and return.
2. Division 26:

    a. Power rough-in and final connection of all power circuits to the controlled environment rooms junction boxes on top of the units.
    b. Remote alarm monitoring wiring and conduit, as directed by the Owner.

1.4 SUBMITTALS

A. General: Submit in accordance with Division 1.

B. Product Data:

1. Submit product data for insulation materials, panel facing materials, refrigeration equipment, lighting, audio-visual alarm, and recording instrumentation.
2. Include information for factory finishes, hardware, glass, sealants, accessories, and other required components.
3. Include name of refrigerant/condenser manufacturer.

C. Shop Drawings:

1. Indicate layout including sections and elevations with dimensions.
2. Submit detail drawings of materials, construction, anchorage devices, and finishes.

D. Samples:

1. Finished exterior panel metal skin:

    a. Two pieces 6” x 6”
2. Finished Floor Samples:

    a. Color samples of not less than ten (10) standard manufacturer’s colors
    b. Architect will select color from manufacturers’ standard colors. Multiple colors may be selected at no change in contract sum.

E. Submit following Informational Submittals:

1. Test Reports: Submit written results of testing specified as part of Source and Field Quality Control articles.
2. Qualification Data: Manufacturer's and installer's qualification data.
3. Manufacturer's instructions.

F. LEED Submittals:

1. Recycled Content (MR4): Submit product data or other published information indicating total weight of product to be provided for the Project, percent of post-consumer recycled material by weight and percent of post-industrial recycled material by weight. Include material costs (excluding costs of installation).
2. For Credit IEQ 4.3: Manufacturers' product data for paints, including printed statement of VOC content.

G. Closeout Submittals:

1. Submit under provisions of Division 1.
2. Project record documents: Record actual locations of mechanical and electrical components, piping, ducts and writing.
3. Special Documentation Requirements:
   a. Labeling of Conductors: Ungrounded current carrying conductors shall be labeled as follows:
      1) Field installed conductors shall be numbered at both ends with the same number. Conductors within the control panel shall be numbered in the same fashion.
      2) Numbered conductors shall have discrete number labels which are not found on any other conductor on the controlled environment room.
      3) The number labels on each numbered conductor shall correspond to labels on the control panel component layout and control system schematic drawings which indicate the point of connection of each labeled conductor.
4. Control System Documentation: The following documentation is required at project completion. It shall be provided in addition to any requirements of the project general conditions. All documentation shall illustrate or describe the as-built condition of the completed work. Provide 2 complete sets of documentation for each room installed. Each set shall be delivered in a three ring binder with the project name and room identifier on the cover.
   a. Drawings of the completed installation showing locations of all equipment and fixtures.
   b. Refrigeration piping schematic.
   c. Compete parts list with all control and refrigeration system parts and the original manufacturer's name and part numbers
   d. Control panel wiring diagram indicating the terminal connections for all ungrounded conductors. All conductor label numbers shall be indicated on the drawings. Conform with other control system documentation requirements of this section.
   e. Control panel interior component layout drawing indicating the numbered wire connections and terminal connection locations for each component. Conform with other control system documentation requirements of this section.
5. Approved copy of operating procedures manual and maintenance data.
6. Warranty: Submit specified warranty.

1.5 QUALITY ASSURANCE

A. Single Source Responsibility:

1. Furnish rooms from one manufacturer for entire Project, unless otherwise indicated.
2. Provide each room as complete unit, including equipment and component items necessary for proper operation.

B. Manufacturer Qualifications: Company specializing in manufacturing Products specified in this Section with minimum 5 years documented experience.

C. Installer Qualifications: Acceptable to manufacturer with documented experience on at least 5 projects of similar nature in past 5 years.

1.6 PRE-INSTALLATION CONFERENCE

A. Conduct pre-installation conference in accordance with Division 1.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of Division 1.

1.8 SEQUENCING

A. Coordinate installation of fire sprinklers, piping, refrigeration lines and condensate drain line with respective sections of Division 22.

B. Coordinate installation of electric power conduit and wiring with respective sections of Division 26.

1.9 WARRANTY

A. Warrant installed room to be free from defects in material and workmanship for 2 years from date of substantial completion.

B. Warrant refrigeration system to be free from defects in material and workmanship for 5 years from date of substantial completion.

C. Include coverage against defects which may arise during the warranty period except those which are caused by misuse.

1.10 MAINTENANCE

A. Service: Provide service and maintenance of room and components for 12 months from date of Substantial Completion to maintain warranty conditions.

PART 2 - PRODUCTS

2.1 GENERAL

A. The Naming of manufacturer(s) and designation of product is for the purpose of identifying and describing required product and not to limit competition. Other manufacturers capable of producing the same appearance and having the same quality, durability, and performance may be proposed for use on this project subject to Architect's approval.

2.2 LEED REQUIREMENTS

A. Give preference to products with materials harvested/extracted/recovered and manufactured/ milled within 500 miles of Project site.

B. Give preference to products containing renewable materials.

C. All field-applied paints and coatings used within the building waterproofing envelope shall comply with Division 09 Section “Interior Painting” and “High-Performance Coatings.”

D. All field-applied adhesives and sealants shall comply with the requirements of Division 01 Section “Indoor Quality Management.”

2.3 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Environmental Growth Chambers, Chagrin Falls, OH.
2. Thermmax Scientific Products, Colmar, PA.
3. Environmental Specialties, Raleigh, NC
4. Harris Environmental Systems, Andover, MA

2.4 MATERIALS

A. Aluminum, Extrusions:

1. ASTM B221M (B221).
2. Alloy: 6063-T5.

B. Galvanized Carbon Steel Sheet:
1. ASTM A446/A446M.
2. Coating Thickness: Z185 (G60).

C. Stainless Steel:
1. ASTM A167.
2. UNS Number S30200.
3. Finish: Number 4.

D. Panel Insulation: Foamed-in-place urethane having a thermal conductivity (“K” Factor) not exceeding 0.125 BTU/Hr/Sq.Ft./degree F/inch of thickness (0.019W/(m*K) The overall coefficient of heat transfer (“U” Factor) shall not exceed .034 (R-30.1) for 4 inch thick walls. Other thickness shall have corresponding higher or lower value. Insulation density shall be 2 lb./cu.ft. minimum.

2.5 COMPONENTS

A. Size:

1. Length: See drawings.
2. Depth: See drawings.
3. Height: 9’-4” nominal exterior height.

B. Panels:

1. Panel Thickness: 4 inches including metal skin and finish thickness.
2. Manufacturer's standard and custom sized panels to provide layout, dimensioned on drawings, or to within 2” of adjacent building walls if no dimensions are given.
3. Fabricate without wood components.
4. Compose entire panel section of panel insulation except for metal skins and internal structural interlock and framing.
5. Fabricate wall and roof-ceiling panels with integral structural support blocking capable of supporting equipment.
6. Fabricate edges of tongue and groove profile.
7. Fabricate panels with foamed-in-place gaskets on each edge to assure airtight seals.
8. Fabricate panels with manufacturer's standard joining devices and panel locks.
9. Provide 1.57 rad (90 degree) corner panel units for each corner.
10. The floor panels shall be clad on the interior and exterior with the specified metal skin and utilize urethane insulation. The floor panels shall allow fastening to the wall panels, and shall be able to withstand uniformly distributed floor loads up to, and including 600 lbs/sq.ft. Floor shall be a maximum of 2 inches thick.
11. Floor Covering: All walk-in room floors shall be covered with a crevice-free, non-absorbent, slip-resistant, abrasive vinyl (90% virgin vinyl matrix) floor covering Altro Walkway 20 or approved equal, inlaid type having temperature stability, dimensional stability and flexibility from -40°C to +60°C. Flooring shall be smooth, free of ribs or patterns. Flooring shall require no maintenance except cleaning with detergent and water. Depending upon room size, floors shall be seamless or seams shall be welded. Floor covering shall be coved up the walls 4 inches high, capped with a vinyl trim piece, and continuously silicone sealed between vinyl cap and walls. Floor covering color shall be selected by Architect.

C. Closure Panels and Trims: Provide closure panels and trims where space exists between room's walls and roof and building's walls, columns, and ceiling. Material and color to match sheet metal of exposed exterior panel skin.

D. Insulation:

1. Nominal 2 inches urethane foam in floors.
2. Nominal 4 inches urethane foam in walls and ceilings.

E. Door:

1. One 36" wide x 77" high minimum clear opening dimension of the doorway.
2. Door shall be provided with cylinder lock, door closer, interior safety latch, and chrome hardware.
3. Construct door same as wall panels.
4. Align door faces flush with faces of wall panels.
5. Door Vision Light: 12” wide x 18" high minimum. Multi-pane assembly, designed to prevent the formation of condensation on the glass or frame under the performance criteria. The window shall be removable for replacement.

F. Hardware:

1. Material: Chrome plated steel, stainless steel, or aluminum.
2. Finish: Satin texture.

G. Hinges:

1. Swing clear configuration to not allow door thickness to obstruct door's clear opening.
2. Provide minimum of three hinges per door.

H. Latch:

1. Provide with cylinder lock.
2. Provide with interior safety release handle connected to lock mechanism to prevent people from being locked inside.
3. Mounting Height: Between 36 and 48 inches above floor surface.

I. Closer:

1. Closing time: Minimum of three seconds to move from 1.22 rad (70 degree) open position to 3 inches from latch, measured from leading edge of the door.
2. Maximum door opening force: 22 N (5 pounds) and as required by ADA guidelines.

J. Gasket:

1. Head and jambs: Thermoplastic with magnetic steel core.
2. Sill: Thermoplastic sweep.

K. Signage: Place card to remind user of hazard caused by spilled specimens and water on room's floor.

L. Condensation and frost prevention heaters:

1. Door and frame assembly shall remain free of condensation under the specified room operating conditions.

M. Lighting:

1. Furnished and install lighting fixtures in each room in an arrangement which will attain the illumination levels specified. Rooms with minimum operating temperatures below 0°C shall be provided with incandescent light fixtures. All others shall be provided with fluorescent fixtures.
2. Fixture Types:

   a. Fluorescent fixtures shall have electronic ballasts rated for operation at the maximum low temperature at the location where they are installed. Fixtures shall be weatherproof type with non-metallic housing and gasketed lens. Each fixture shall accommodate two 48” size T-8 lamps. Provide 750 lx (70 foot candles) of illumination at 40 inches above the floor measured at + 25°C.

N. Furnish and install all electrical items in Controlled Environment Rooms as indicated on Electrical Drawings. All materials shall be in accordance with specifications Section 260002 – ELECTRICAL WORK and Section 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.

2.6 FINISHES

A. Exterior: Factory applied baked white polyester on galvanized steel. Galvalume will not be acceptable. Smooth finish.

B. Interior: Factory applied baked white polyester on galvanized steel. Galvalume will not be acceptable. Smooth finish.

2.7 EQUIPMENT

A. All equipment and componentry shall be listed by a NRTL (Nationally Recognized Testing Laboratory) to be suitable for application to which it is applied on this project. Major assemblies, including condensing units and control panels shall be tested and labeled by a NRTL in accordance with a suitable applicable nationally recognized standard.

B. Refrigeration system:

1. All rooms shall be provided with mechanical cooling system as specified herein. The refrigeration system shall be an integral part of the control and conditioning system. Condensing unit shall be located above on the exterior ceiling of each room and shall be installed by the manufacturer. Coordinate final connections to building services with plumbing, mechanical and electrical contractors.

a. System shall incorporate industrial type accessible semi-hermetic compressor, operating continuously. Include all components necessary to accomplish effective, efficient, serviceable installation. System shall consist of, but not limited to, accessible semi-hermetic compressor, receiver, liquid cooled condenser, evaporator, moisture indicating sight glass, liquid filter-drier, high and low pressure controls, crankcase pressure regulator, suction accumulator, suction line filter, expansion valve, oil level, sight glass, condenser pressure regulator, manual shut-off valves and all interconnecting piping, insulation and wiring.
b. System capacity control shall be accomplished with hot gas bypass which continuously mixes liquid and gaseous refrigerant to achieve the selected performance of the system.
c. Condensing units shall be provided with automatic reset high and low pressure controls.
d. Provide 2-way or 3-way (as required by condenser water design) condenser water regulating valve.
e. Provide solenoid valves for operation with a manual pump down switch included with the main control panel.
f. Ceiling Conditioning Unit: The air in the room shall be conditioned by a conditioning unit. It shall contain all interior cooling, heating, and air moving equipment within a housing fabricated of smooth white aluminum. Service to the internal components shall be via removable panels on the housing. The bottom of the housing shall serve as a condensate drain pan. The conditioning unit shall be completely pre-assembled, and tested prior to shipment, requiring only field connection to controller and condensing units. Provide required house keeping pad, and mount condenser on base with vibration isolators.
g. Air movers shall be aluminum bladed fans with permanently lubricated motors.
h. Evaporator coil shall be fabricated of copper tubes and aluminum fins. Suspend unit from roof-ceiling panels, and provide connection for condensate drain pipes to drip pan.
i. Condensate drain pan shall be heated on all units with operating temperature range extending below 0°C.

2.8 ACCESSORIES

A. Shelving:

1. Provide wall mounted, removable adjustable wire shelving as indicated on drawings. All shelving, wall mounting brackets, and standards shall be constructed of stainless steel, with a minimum of five years corrosion resistance guarantee. Shelving shall be removable without special tools.

B. Casework:

1. All work benches and tables shall be constructed of stainless steel for corrosion resistance and durability. All tubular legs shall be stainless steel. Sizes of casework and accessories are as shown on drawings, and as specified in Section 123450.

C. Penetrations for Pipe and Conduit through Panels:

1. Provide for each penetration through room's walls and roof-ceiling.
2. Seal penetrations, from both ends with silicone sealant, to prevent air infiltration into room and insulate to prevent condensation at pipes, conduit, and junction boxes.

2.9 CONTROLS

A. Control Console:

1. A control console incorporating a key locked door with a clear acrylic window shall be required for viewing and protecting the settable controls. The console shall be mounted on the controlled environment room exterior next to the door if possible. All controls, switches, pilot lights, alarms and temperature recorder shall be housed in a welded heavy gauge painted steel control console.
2. All ungrounded conductors in the control panel and their field wired extensions shall be uniquely numbered at each end with a suitably applied label. The labels shall be permanent and machine printed. Hand marking of conductors or application of tapes with hand written markings will not be accepted.
3. Control panel components shall be assigned a name, tag, or other identifier which shall be utilized throughout the system documentation to describe or refer to that component.
4. Complete control panel assembly shall be tested and certified by a NRTL to be in accordance with NFPA 70 and NFPA 79. A certifying label from the testing agency shall be applied to the exterior of each control panel.
5. Control system shall include both audible and visible alarm indicators of high or low alarm conditions, with remote alarm dry contacts for connection to building monitoring systems. High/low safety alarms set digitally in 0.1° C or 0.1% RH increments.
6. Alarm buzzer shall be equipped with field adjustable alarm delay timer and manual alarm silence switch which will temporarily silence alarm buzzer.

B. Temperature Controller:

1. Temperature control shall be through a solid state microprocessor based digital control with RTD sensing. The control components shall control capacity of the refrigeration/conditioning system and be designed to meet the performance criteria of the room. Setpoint shall be through the digital control and readout shall be in degrees Centigrade. The controller shall simultaneously display the actual condition and setpoint.

C. High/Low Temperature Safety Alarms:

1. Separately adjustable high and low limit control circuits shall be provided in the control panel. Limit controllers shall be electronic, with digital setpoint and display of current room temperature. Hydraulic actuated devices, or those with reference dials shall not be permitted. Limit control shall have its own sensor, independent from all others.
2. Control system shall include both audible and visible alarm indicators of high or low alarm conditions, with remote alarm dry contacts for connection to building monitoring systems.
3. Alarm buzzer shall be equipped with field adjustable alarm delay timer and manual alarm silence switch which will temporarily silence alarm buzzer.

4. Provide functions and devices as follows:

   a. High Limit: In the event of a high temperature limit condition, the limit control will de-energize all heat producing devices loaded on the control panel power circuits, illuminate a red pilot light and sound an audio alarm. Additionally, the control circuit shall have a normally open contact wired in series with the compressor contactor control signal to provide immediate and direct shutdown of the compressor. When temperature returns to the normal range the system shall reset by one of the methods below. Reset methods shall be operator selectable with a front panel mounted switch. Provide a normally open and normally closed relay contact for connection to building alarm system.
   b. Low Limit: In the event of a low temperature limit condition, the safety control will directly open the compressor contactor, activate a red pilot light and sound an audio alarm. Limit control circuit shall have a normally open contact wired in series with the compressor contactor control signal. Systems which rely on low pressure switch action to shutdown compressor will not be accepted,. When temperature returns to the normal range the system shall reset by one of the methods below. Reset method shall be operator selectable with a front panel mounted switch. Provide a normally open and normally closed relay contact for connections to building alarm system.
   c. Reset methods for high and low limit:
      1) Manual reset shall prevent restart of the equipment until the operator has pressed a reset button on the control panel face.
      2) Automatic reset will cause the equipment to restart when the room temperature returns to the normal range.

D. Defrost Control:

1. Defrost controls shall be installed on all rooms with specified operating temperature extending below +6°C. Cycle shall consist of controlled heating and then cooling of the evaporator coil, removing any accumulated frost while minimizing the impact on room performance. All rooms shall be defrosted with compressor discharge gas. Defrost cycle control shall be considered an essential element of room operation. Defrost controls shall perform the following functions:

   a. Defrost cycle initiation will automatically be skipped if room temperature is above a preset limit. Limit shall be adjustable on the front of the control panel. Fans shall be off during the heating phase of the cycle. Initiation of the heating portion shall be accomplished in two ways:
      1) Operator can manually initiate a defrost cycle with a switch on the control panel face. Cycle shall start immediately upon operation of the switch.
      2) An electronic timing device shall automatically initiate defrost cycles at predetermined adjustable intervals
   b. Four methods of terminating the heating portion of the cycle shall be provided:
      1) Termination shall occur when evaporator temperature or suction pressure reaches a preset adjustable level.
      2) An increase in room air temperature by a predetermined amount shall cause the heating portion of the cycle to terminate. This maximum room temperature rise limit shall be adjustable on the control panel face.
      3) The expiration of a preset time period allowed for coil heating shall cause the heating cycle to terminate. This function shall be considered to be a secondary method. Defrost cycles shall normally terminate by the detection of a rise in evaporator temperature or suction pressure.
      4) The heating cycle can be manually terminated by the operator. A switch on the control panel face shall be provided for this function. Operation of the switch shall immediately terminate an active defrost cycle.

c. After the heating cycle is terminated, the evaporator shall be cooled to an adjustable fan cut-in temperature and the fan shall begin operation. This function shall be automatically disabled when the room is operating above temperatures where defrost is required.

d. Coordination of the defrost cycle and operation of other heat producing equipment shall be accomplished to minimize the effect on room temperature rise during the defrost cycle.

E. Recorder:

1. Provide a solid state temperature recorder with a seven day or twenty-four hour chart movement which is switch selectable. The recorder shall utilize a 10 inch circular chart. On controlled environment rooms with humidity control, provide a second pen for recording of RH levels with the room. The same sensor shall be utilized for control and to record RH levels with the room. The thermometer shall be calibrated below and above the operating range of the room and the hygrometer shall be calibrated over the range of 10% to 98%. Recorder accuracy shall be 1% full scale.

2.10 MECHANICAL DESIGN

A. Fresh Air Exchange:

1. Controlled environment rooms shall be provided with inlet and outlet connections for fresh air supply and exhaust from the building HVAC system. Air flow rate shall be as scheduled, and shall be continuous.

2.11 SPECIAL REQUIREMENTS

A. +4° C Walk-In Cold Room

1. Use: Lab & Storage
2. Temperature: +4°C
3. Fresh Air Volume: 24L/s (50 cfm)
4. Relative Humidity: Maximum 65%
5. Number of people working in room at one time: 2
6. Door openings: Personnel entering and leaving the room at a rate of 6 openings per hour
7. Special Requirements: See Lab Drawings for casework, shelving and other special requirements.
8. Electrical Devices Within Room: See Electrical Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions and proceed with work in accordance with Division 1.

B. Verify mechanical and electrical services to room are roughed-in and ready for connection to room equipment, plumbing, and wiring.

3.2 INSTALLATION

A. Install units plumb, level, square, and free from warp and twist while maintaining dimensional tolerances and alignment with surrounding construction.

B. Fabricate panels with manufacturer's standard joining devices.

C. Join panel edges to each other using steel straps set in panel insulation.

D. Field wire electrical devices to a single point for each voltage for connection to outside power supply and monitoring devices.

E. Closure Panels: Provide closure panels, to match sheet metal of exposed exterior panel skin, where space exists between room's walls and roof and building's walls, columns, and ceiling.

F. Interface With Other Work:

1. Coordinate with Division 22:
   a. Sizing and location of condenser-to-evaporator or piping
2. Coordinate with Division 26:
   a. Location of power connection to outside power supply.
   b. Remote monitoring devices.
3. Penetrations for Pipe and Conduit through Panels:
   a. Coordinate with respective trades.
   b. Seal penetrations to prevent air infiltration and condensation.

3.3 FIELD QUALITY CONTROL

A. Site Tests:

1. Comply with requirements of Division 1.
2. Operational Function Testing:
   a. Simulate and verify all alarm and limit functions
   b. Operate and verify all defrost functions and their coordination with other room functions.
   c. Verify operation of all specified functions and switches.
   d. Prepare a detailed written report indicating the step by step procedure used to perform tests. Indicate the specific results of each step.
3. Performance Testing:
   a. All rooms shall be tested for compliance with the specified thermal requirements. Test and measure each room for compliance with specified Thermal Requirements using digital data logger and at least 6 sensors widely spaced throughout the room. Test duration shall be minimum 24 hours per room. Sampling interval shall be less than 3 minutes. Turn over raw data, plotted data and analysis to Architect for approval. Additionally, test for door opening recovery time and defrost temperature rise.
   b. Rooms with relative humidity control shall be tested for humidity control performance and recovery.
   c. Test instrumentation shall have documented accuracy sufficient to effectively test the rooms. Submit calibration report as evidence of accuracy. Resolution shall be 0.1°C or better for temperature, 1% for relative humidity.
   d. Test setpoints for temperature:
      1) Rooms with a temperature span (difference between highest and lowest operating temperatures) of 10 degrees or less shall be tested at the midpoint of the temperature range or the indicated operating temperature.
      2) Rooms with a temperature span greater than 10 degrees, but less than 21 degrees, shall be tested at the highest and lowest setpoints in the range.

3) All other rooms shall be tested at the highest, lowest and midpoint operating temperature setpoints.

e. Test conditions for relative humidity:

1) Rooms with a single operating point shall be tested at that point.

2) All other rooms shall be tested at the highest and lowest temperature and relative humidity combinations scheduled. This requires testing at 4 possible combinations of high and low temperature and humidity conditions.

4. Refrigeration system testing:

a. Clean, pressure test, dehydrate, and separately vacuum test unit.

b. Test Duration: 5 Hours.

c. Perform the following number of times: One.

d. Pressure test minimum of 690 kPa (100 pounds per square inch) above operating pressure.

e. Vacuum test at 96.5 kPa (28.5 inches of mercury) or less.

f. Charge system with required amount of refrigerant and oil then retest system.

5. Deficiencies in performance or operation evidenced by the tests shall be remedied by the manufacturer and the room shall be re-tested.

3.4 ADJUSTING

A. Adjust parts for smooth, uniform operation.

3.5 CLEANING

A. Clean as required by manufacturer. Do not use materials and methods which may damage finish and surrounding construction.

3.6 DEMONSTRATION

A. Provide system demonstration at mutually agreed upon time to Owner.

B. Demonstrate refrigeration system maintenance control and alarm operations.

3.7 PROTECTION

A. Protect finished work in accordance with Division 1.

END OF SECTION 130390

PART 1 - GENERAL

1.1 DESCRIPTION

A. Fabrication and Installation of aquarium vessels and LSS components.

1. The work includes, but is not necessarily limited to, the following:
   a. Custom fiberglass tanks
   b. *Pre-manufactured* polyethylene tanks
   c. Tower packing media
   d. Testing and instruction.
   e. Maintenance and warranty

2. Electrical contractor to provide all power to LSS components. LSS contractor shall rough-in equipment, but electrical connections are by others. This includes all:
   a. Pumps
   b. UV sterilizers
   c. Heat exchangers
   d. Exhibit lights
   e. Service outlets
   f. Other ancillary LSS equipment

3. Connection of heat exchanger to building's chilled loop to be done by others.

4. All pipe penetrations between floors to be provided for LSS contractor.

1.2 RELATED SECTIONS

A. ELECTRICAL Division 16

B. PLUMBING Division 15

1.3 REFERENCES

A. Standards and Codes that apply to the Work of this Section:
   1.
   2. RE NEC — National Electric Code, current edition.
   3. UPC — Uniform Plumbing Code, current edition.
   4. ASTM — ASTM International:
   5.
      a. B 3 — Specification for Soft or Annealed Copper Wire.
      b. D 1784 — Specification for Rigid PVC Compounds and CPVC Compounds.
      c. D 1785 — Specification for PVC Plastic Pipe, Schedules 40.
      d. D 2287 — Specification for Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds.
      e. D 2241 — Specification for PVC Pressure-Rated Pipe (SDR Series).
      f. D 2464 — Specification for Threaded PVC Plastic Pipe Fittings, Schedule 80.
      g. D 2466 — Specification for PVC Plastic Pipe Fittings, Schedule 40.
      h. D 2564 — Specification for Solvent Cements for PVC Plastic Piping Systems.
      i. D 2672 —F 690 — Practice for Underground Installation of Thermoplastic Pressure Piping Irrigation Systems.
   6. ANSI — American National Standards Institute: NSF 14— Plastics Piping Components and Related Materials.

7. United States Green Building Council (USGBC) — Leadership in Energy and Environmental Design (LEEDTM) Green Building Rating System for Core and Shell Development (CS) Version 2.0. www.usgbc.org

1.4 DEFINITIONS

A. The following are industry abbreviations for irrigation materials.
   1.
   2. Acceptance, Acceptable, or Accepted: Acceptance by the Architect in writing.
   3. PVC: Polyvinyl Chloride.
   4. HDPE: High Density Polyethylene
   5. SDR: Standard Dimensional Ratio.
   6. AWG: American Wire Gauge.

1.5 SUBMITTALS

A. Refer to and comply with Section 01300, Submittals, for procedure and additional submittal criteria.

B. Product Data: Manufacturer or suppliers descriptive literature including installation instructions, for each specified product.

C. Credentials: Name and qualifications of the aquarium contractor who has had at least five (5) comparable projects of similar work and scope that the Contractor has completed within the last five (5) years with job locations, names of owners and architects, their phone numbers, and dates on which the work on each project was started and completed.

D. Certifications: Written certification from each product manufacturer or supplier stating that their product conforms to the specified requirements and that all products do not contain hazardous materials.

E. Shop Drawings:

   1. Show layouts of system(s) relate to and adjusted together with layouts of on-site design conditions and plantings.

F. Operating and Maintenance Manual: Three (3) manuals describing in detail the step-by-step procedures required for system start-up, operation and shut down of the entire LSS. Operating manuals shall include the manufacturer's name, model number, parts list and brief description of all equipment and their basic operating features. Maintenance manuals shall list routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. Index and arrange the manuals in proper order; include copies of all product literature and their warranties.

G. Warranty: On company letterhead submit a written warranty in the following format:

   1. Warranty for ** NAME OF PROJECT** aquarium sys.
   2. We hereby guarantee that the irrigation system we have furnished and installed for **NAME OF PROJECT** is free from defects in materials and workmanship, and the work has been completed in accordance with the drawings and specifications, ordinary wear and tear and unusual abuse, or neglect expected. We agree to repair or replace any defects in material or workmanship which may develop during the period of one year from date of acceptance and also to repair or replace any damage resulting from repairing or replacing of such defects at no additional cost to the City, after receipt of written notice.

      Contractor Name
      Signature: Title:
      Date:

1.6 COORDINATION

A. Thoroughly coordinate and schedule the work of this Section with all trades involved to prevent interferences, and in order to allow adequate time at the proper stage of construction to properly perform all work of this Section.

B. A pre-installation meeting will be held, at a time requested by the construction manager, in order to coordinate all trades and requirements of this Section. Representatives from Architects, Construction Manager, Architects and Contractors are to attend.

C. Coordinate location of all piping and sleeves to be installed with the general contractor.

1.7 QUALITY ASSURANCE

A. It is the intent of these Specifications and Drawings to provide for a complete installation. Therefore, any items not specifically noted but, reasonably necessary for a complete installation, to be furnished. The system is to provide robust LSS and aquarium system for the support of marine organisms found in New England.

B. Obtain and pay for all required inspections, permits, and fees. Provide notices required by governmental authorities.

C. Qualifications:

1. Experienced Contractors are required who are thoroughly trained and experienced in the skills required to install LSS and aquarium systems, and who will have a qualified superintendent present, at all times, during the installation. Contractors to have a minimum of five (5) years experience in the installation of LSS and aquarium systems and must be regularly engaged in and which maintains a regular work force in the installation of aquaria.

2. Materials, equipment, and methods of installation will comply with the applicable requirements of the authorities having jurisdiction including the following codes and standards:

a. City of Hamden/State of Connecticut Building Codes
b. National Fire Protection Association, (NFPA): National Electrical Code.
c. American Society for Testing and Materials, (ASTM).
d. National Sanitation Foundation, (NSF).

1.8 JOB CONDITIONS

A. Locate and identify existing underground and overhead services and utilities within the contract limits. Install adequate means of protection of utilities and services designated to remain. Repair utilities damaged during work operations of this Section at the Contractor's expense.

B. When uncharted or incorrectly charted underground piping or other utilities and services are encountered during site work operations, notify the Owner's Representative and applicable utility company immediately to obtain procedural directions.

C. Cooperate with the applicable utility company in maintaining active services in operation.

1.9 FINAL REVIEW AND ACCEPTANCE

A. When all LSS and aquarium work is completed and the “Construction Record Drawing” has been submitted a final review of the LSS and aquarium system will be made by the Owner’s Representative, upon written notice requesting such a review. Submit the written notice at least ten (10) days prior to the anticipated review.

B. Upon final review and acceptance, the Owner's Representative will notify the Owner, in writing, as to final acceptance of the LSS and aquarium system. Date of the final acceptance by the Owner is the date beginning the warranty period.

C. Any LSS and aquarium system equipment item required under this contract that is malfunctioning or in need of repair is to be removed and replaced. All replacements are to be of equipment and/or material originally specified. The cost of replacement is to be borne by the Contractor.

D. Upon acceptance of the entire system, instruct the Owner's designated personnel in the complete operation of the entire system.

1.10 WARRANTY

A. Warranty the entire LSS and aquarium system and all related equipment and accessories for a period of one (1) year from the date of final acceptance against all defects in workmanship and material.

B. The warranty period will commence upon final acceptance by the Owner for a complete system and/or any portion thereof has been put into operation and acceptable to the Owner's Representative.

1.11 MAINTENANCE

A. None required.

1.12 DELIVERY, STORAGE, AND HANDLING

A. Deliver the LSS and aquarium system components in the manufacturer's original undamaged and unopened containers with labels intact and legible.

B. Deliver plastic piping in bundles, packaged to provide adequate protection of pipe ends, both threaded or plain.

C. Handle materials to prevent damage.

D. Store materials to protect from sunlight, temperature variation and weather.

E. Provide secure, locked storage for valves, contact vessels, and similar components that can not be immediately replaced, to prevent installation delays.

PART 2 - PRODUCTS

2.1 LSS/AQUARIUM MANUFACTURERS

A. Harrington Corporation, Lynchburg, Virginia

B. Aqualogic Inc, San Diego, California

C. RK2, San Diego, California

D. My Reef Creations, Atlanta, Georgia

E. Pentair Products, Charlotte, North Carolina

F. LifeGard Aquatics, San Diego, California

G. Waterdog Products, El Cajon, California

H. Tank Depot, Orlando, Florida

I. Cemrock, Tucson, Arizona

J. Red Ewald, Dallas, Texas

K. Emperor Aquatics, Bedford, Pennsylvania

L. Aquatic Ecosystems, Sarasota, Florida

M. Solar Components, Nashua, New Hampshire

2.2 MATERIALS

A. All LSS and aquarium system is to be provided by an authorized distributor.

B. All materials and equipment used in the construction work and not specifically noted as being furnished by the Owner, to be furnished by the Contractor. All material and equipment furnished by the Contractor to be new, of the kind and type specified, of good quality, and to be delivered to the site in good condition. All materials, whether furnished by the Contractor or by the Owner, to be protected by the Contractor until incorporated in the work and finally accepted by the Owner.

C. Tank and vessel guidelines

1. Tanks shall be constructed of fiberglass reinforced plastic (FRP) with epoxy based vinyl ester resin interior coat.
2. Tanks shall be sized and configured as shown on the contract drawings to accomplish the purpose and function shown therein.
3. Tanks shall be manufactured to meet the specified pressure ratings. Contractor to submit manufacturers certification of pressure rating.
4. Plumbing connections shall be sized and positioned as shown on drawings.
5. All fastening hardware on flanges, manways, viewing ports, air vents, etc. shall be 316 stainless steel.
6. Knuckle and Ocean aquarium shall be custom built. The touch tank will be pre-manufactured.

D. General LSS requirements:

1. All valves used shall be true union with seals rated for salt water.
2. All pipe and conduit runs shall be supported by approved means with approved hangars.
3. All pipe and conduit runs shall be supported per applicable code requirements.
4. All conduits, pipes, wire, etc., which will no longer be in service, shall be demolished.
5. All sleeves through floor slabs shall extend 2” above the floor. All penetrations through floor slabs and walls shall be sealed with fire-rated caulking (work not to be done by LSS contractor).
6. All threaded rod used in damp locations shall be stainless steel.
7. All hangars used in damp locations shall be non-metallic or stainless steel.
8. All hardware used in damp locations shall be non-metallic or stainless steel.
9. All plumbing equipment shall have valves and unions for easy isolation and removal.
10. All flanges shall be bolted fully with each bolt passing through all nut threads.
11. All plumbing piping shall be marked using “Kwik Koil” pipe markers or equivalent.
12. All valves shall be marked using brass or stainless steel tags.
13. Plumbing Saddles can be used on process control probes ONLY.

14. Drilling and tapping a PVC pipe run for installing a fitting is unacceptable.
15. All plumbing PVC pipe & fittings shall be Schedule 80 by Charlotte, Eslon or Spears.
16. PVC Unions shall be made by Eslon. NO SUBSTITUTIONS.
17. Plumbing mounting brackets, struts and clamps shall be made by Enduro
18. Stainless Steel shall be type 316.
19. Floor Drains shall be Heavy Duty and made by Town and Country (not in LSS contractors scope).
20. Pipe hangars shall be Fiberglass and made by Enduro.
21. Concrete inserts shall be Stainless Steel.
22. Copper pipe supports shall be strut and plastic clips w/ clear vinyl sleeves by Enduro (not in LSS contractor's scope)
23. Pipe supports shall be installed 4' O.C. and within 12" of all suction/ discharges.
24. Gasoila and Teflon tape shall be used on all threaded connections.
25. Equipment anchor bolts shall be stainless steel.
26. Heat Exchanger Plates shall be stainless steel.
27. Escutcheon Plates shall be stainless steel.
28. Drop in Anchors shall be stainless steel and made by Red Head.
29. Wedge Bolts shall be stainless steel and made by Rawl.
30. All studs for mounting equipment shall be stainless steel.
31. Zamac anchors will be allowed on lines up to 1" with Enduro Channel.
32. No single or two hole pipe bands shall be used on any installation.
33. All NPT threaded joints shall be Teflon Taped then Gasoila added before installation.
34. All pumps shall be laser aligned after installation if applicable.
35. Only Chesterton (440 or Streamline) seals are acceptable on all three phase pumps.
36. All three phase horizontal pumps over 3 HP shall be Fybroc brand.
37. All three phase vertical pumps shall be Fybroc or Goulds.
38. Single phase pumps shall be Hayward or Speck or LifeGard.
39. Ball valves 2" and smaller shall be Asahi with Viton seals and Teflon seats.
40. Gate valves shall be Asahi with viewable throttle position.
41. Check valves shall be Asahi with Viton seals and Teflon seats
42. Butterfly Valves shall be Asahi, type 75 with EPDM liner and Stainless Steel shafts.
43. Final electrical conduit runs within 3 feet of equipment shall be in flexible conduit.
44. Minimum electrical circuit wiring shall be capable of carrying 15 amperes.
45. Minimum electrical conduit size shall be 3⁄4".
46. All three phase motors shall have motor starters with overload protection.
47. All equipment shall have an electrical disconnecting means within 3' if applicable.
48. All electrical PVC conduits shall be Schedule 40 minimum.

49. PVC and Rob-Roy piping are the only electrical conduits to be used in damp locations.

50. When installing metal stud walls, the metal stud track should be anchored into 2 x 4 treated lumber that is anchored to the floor.

E.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the areas and conditions where aquarium and LSS is to be installed. Notify the Owner's Representative, in writing, of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Owner's Representative.

3.2 CUTTING AND PATCHING

A. Methods and materials used for cutting and patching to be acceptable to the Architect.

B. Materials and finishes for all patching to match existing cut surface materials and finish.

C. Cut through concrete and masonry with core drills. Jack hammers not permitted.

D. Seal all openings in exterior walls water tight with link seals.

E. Cutting and patching work, including the installation of sleeves required to accommodate installation of LSS and aquarium to be performed by others.

3.3 CONDUIT:

A. Install all electrical conduits for 24V control wiring.

B. Backfill and thoroughly compact around all conduit.

C. All conduits to have a minimum cover of twenty four inches (24").

D. Pipe Laying:

1. Inspect the pipe for defects before installation and fusion. Defective, damaged or unsound pipe will be rejected.

2. Pipe to be installed in accordance with ANSI/ASAE Standard #S376.1 and the printed instructions of the manufacturer, including leveling of trench bottoms, bedding of pipe in bottom trench and securely thrusting any fittings to change direction of gasketed pipe.

3. Allow joints to set at least 24 hours before pressure is applied to the system.

4. Maintain pipe interiors free of dirt and debris. Close open ends of pipe by acceptable methods when pipe installation is not in progress.

3.4 HYDRO TESTING

A. The complete aquarium and LSS need to be tested for 24 hours to assure there are no leaks and system functions properly.

3.5 CLEAN UP AND PROTECTION

A. Upon completion of all work of this Section, remove and legally dispose of all excess materials resulting from the work operations of this Section.

B. Accumulation of materials for disposal is not permitted. Disposal is to be made as fast as materials accumulate.

END OF SECTION 328000

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. This Section includes, but is not limited to, all materials, labor and equipment, complete with all anchors and related accessory, necessary to furnish, deliver and install:

1. Environmental Growth Chamber with Lighted Shelves
2. Reach-In Growth Chamber Unit

B. Although such work is not specifically shown or specified, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.

C. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 018113, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

D. Related Sections:

1. Section 11 60 00 - Laboratory Equipment-General Requirements: Equipment schedule
2. Division 22 - Plumbing: Plumbing piping.
3. Division 26 - Electrical: Conduit and wiring to points of connection in junction box.

1.3 SYSTEM DESCRIPTION

A. Design Requirements:

1. Manufacturer is responsible for designing units, including refrigeration system, anchorage of units to structural system and necessary modifications to meet specified requirements and maintain visual design concepts.
2. Door-opening temperature recovery period: Following a 15 second door opening, the chamber temperature shall recover within 3 minutes.
3. Drawings are diagrammatic and are intended to establish basic dimension of units, sight lines, and profiles of units.
4. Provide concealed fastening whenever possible.
5. Attachment considerations: Account for site peculiarities and expansion and contraction movements so there is no possibility of loosening, weakening and fracturing connection between piping and units.
6. Provide unit complete with power and environmental control wiring, power and environmental control mechanisms, terminated at a single point for each voltage for connection to power supply.
7. Dimensions, voltages, electrical power requirements, and utility connections are based on the items specified. Contractor shall be responsible for all costs for dimensional

adjustments and for providing or arranging for additional electrical or utility services or equipment required as a result of using an equal product.

8. All chambers to be assembled and tested at the factory. Equipment may be inspected by Owner at manufacturer's plant prior to shipment. Equipment found not in accord with specifications and approved Drawings may be rejected. Replace rejected equipment at no cost to Owner.
9. Electric operated and/or heated equipment: The entire cabinet must be certified and comply with the latest electrical standards of the National Electric Code (NEC), and Underwriters' Laboratories, Inc., (UL).

B. Interface with Adjacent Systems. The following items are incidental to this Section and provided by other Specification Sections:

1. Division 22:

   a. Service piping to connection point. Service system and piping within the environmental growth chambers to be provided by growth chamber manufacturer.

2. Division 26:

   a. Power rough-in to weatherproof junction box for 208 volt load and final connection.
   b. Power rough-in to junction box for 120 volt load and final connection.
   c. Remote alarm monitoring wiring and conduit.

1.4 QUALITY ASSURANCE

A. Single Source Responsibility:

1. Furnish products for each type of growth chamber from one manufacturer for entire Project, unless otherwise acceptable to Architect.
2. Provide each product as complete unit, including accessory items necessary for proper operation.

B. Manufacturer Qualifications: Company specializing in manufacturing Products specified in this Section with minimum 5 years documented experience.

C. Installer Qualifications: Manufacturer, or approved in writing by manufacturer.

1.5 SUBMITTALS

A. General: Submit in accordance with Division 1.

B. Product Data:

1. Submit product data.
2. Include data to indicate equipment dimensions and construction, equipment capacities, and point loads.
3. Include information for factory finishes, hardware, glass, sealants, accessories, and other required components.
4. Include wiring diagrams and rough-in requirements.

C. Shop Drawings:

1. Indicate typical layout including sections and elevations with dimensions.
2. Submit detail drawings of materials, construction, anchorage devices, and finishes.

D. Submit following Informational Submittals:

1. Test Reports: Submit written results of testing specified as part of Source and Field Quality Control articles.
2. Qualification Data: Manufacturer's and installer's qualification data.
3. Manufacturer's instructions.

E. Samples:

1. Finishes.
2. Include color charts for finish indicating manufacturer's full range of colors available for selection.

F. Closeout Submittals:

1. Submit under provisions of Division 1.
2. Project record documents: Record actual locations of mechanical and electrical components, piping, ducts and writing.
3. Operation and maintenance data.
4. Warranty: Submit specified warranty.

G. LEED Submittals:

1. Recycled Content (MR4): Submit product data or other published information indicating total weight of product to be provided for the Project, percent of post-consumer recycled material by weight and percent of post-industrial recycled material by weight. Include material costs (excluding costs of installation).
2. For Credit IEQ 4.3: Manufacturers' product data for paints, including printed statement of VOC content.

1.6 PRE-INSTALLATION CONFERENCE

A. Conduct pre-installation conference in accordance with Division 1.

B. Convene pre-installation conference one week prior to commencing work of this Section.

C. Attendance Required: Owner, Architect, Contractor, Manufacturer's Representative, and Installer.

D. Agenda: Discuss and agree upon acceptable substrate and support conditions, preparatory work, interface with mechanical and electrical services, and methods of installation and testing.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of Division 1.

1.8 WARRANTY

A. Comply with provisions of Division 1.

B. Warrant installed room to be free from defects in material and workmanship for 2 years from date of substantial completion.

C. Warrant refrigeration system to be free from defects in material and workmanship for 5 years from date of substantial completion.

D. Warrant insulated panels to be free from defects in material and workmanship for 10 years from date of substantial completion.

E. Include coverage against defects which may arise during the warranty period except those which are caused by misuse.

1.9 MAINTENANCE

A. Service: Provide start up and yearly service and maintenance of growth chambers and components for 24 months from date of Substantial Completion to maintain warranty conditions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:

1. Conviron, Winnipeg, Canada
2. Environmental Growth Chambers, Chagrin Falls, OH
3. Environmental Specialties Inc., Raleigh, NC
4. Percival Scientific, Inc., Perry, IA

2.2 MATERIALS

A. Aluminum, Extrusions:

1. ASTM B221M (B221).
2. Alloy: 6063-T5.

B. Galvanized Carbon Steel Sheet:

1. ASTM A446/A446M.
2. Coating Thickness: Z185 (G60).

C. Stainless Steel:

1. ASTM A167.
2. UNS Number S30200.
3. Finish: Number 4.

D. Panel Insulation: Foamed-in-place urethane having a thermal conductivity (“K” Factor) not exceeding 0.125 BTU/Hr/Sq.Ft./degree F/inch of thickness (0.019W/(m*K). The overall coefficient of heat transfer (“U” Factor) shall not exceed .034 (R-30.1) for 4 inch thick walls. Other thickness shall have corresponding higher or lower value. Insulation density shall be 2 lb./cu.ft. minimum.

2.3 COMPONENTS

A. Size:

1. Length: See drawings.
2. Depth: See drawings.
3. Height: 9'-4" nominal exterior height.

B. Panels:

1. Panel Thickness: 4 inches including metal skin and finish thickness.
2. Manufacturer's standard and custom sized panels to provide layout, dimensioned on drawings, or to within 2” of adjacent building walls if no dimensions are given.
3. Fabricate without wood components.
4. Compose entire panel section of panel insulation except for metal skins and internal structural interlock and framing.
5. Fabricate edges of tongue and groove profile.
6. Fabricate panels with foamed-in-place gaskets on each edge to assure airtight seals.
7. Fabricate panels with manufacturer's standard joining devices and panel locks.
8. Provide 1.57 rad (90 degree) corner panel units for each corner.
9. Closure panels: Match sheet metal of exposed exterior panel skin.

C. Insulation:

1. Nominal 4 inches urethane foam in walls and ceilings.

D. Door:

1. One 36" x 77" minimum clear opening dimension of the doorway.
2. Door shall be provided with cylinder lock, door closer, interior safety latch, and brushed aluminum hardware.
3. Construct door same as wall panels.
4. Align door faces flush with faces of wall panels.
5. Door Vision Light: 14"W x 14"H minimum. Multi-pane assembly, designed to prevent the formation of condensation on the glass or frame under the performance criteria. The window shall be removable for replacement. A light tight cover over the window shall be included.

E. Hardware:

1. Material: Chrome plated steel, stainless steel, or brushed aluminum.
2. Finish: Satin texture.

F. Hinges:

1. Swing clear configuration to not allow door thickness to obstruct door's clear opening.

G. Latch:

1. Provide with cylinder lock.
2. Provide with interior safety release handle connected to lock mechanism to prevent people from being locked inside.
3. Mounting Height: Between 36 and 48 inches above floor surface.

H. Closer:

1. Closing time: Minimum of three seconds to move from 1.22 rad (70 degree) open position to 3 inches from latch, measured from leading edge of the door.

2. Maximum door opening force: 22 N (5 pounds) and as required by ADA guidelines.

I. Gasket:

1. Head and jambs: Thermoplastic with magnetic steel core.
2. Sill: Thermoplastic sweep.

J. Signage: Place card to remind user of hazard caused by spilled specimens and water on room's floor.

K. Lighting:

1. There shall be three (3) lighted tiers in each shelf section with a total of (4) shelf sections in the chamber. Each fixture will consist of eight 32 watt T8 lamps. The lamps will be controlled from the microprocessor controller located in the control console. The lamps will be programmed in pairs and the lamps on the different shelf levels will be controlled simultaneously.

L. Furnish and install all electrical items in Controlled Environment Rooms as indicated on Electrical Drawings. All materials shall be in accordance with Division 26 – Electrical specifications.

2.4 FINISHES

A. Exterior: Factory applied baked white polyester on galvanized steel. Galvalume will not be acceptable.

B. Interior: Factory applied baked white polyester on galvanized steel. Galvalume will not be acceptable.

2.5 EQUIPMENT

A. All equipment and componentry shall be listed by a NRTL (Nationally Recognized Testing Laboratory) to be suitable for application to which it is applied on this project. Major assemblies, including condensing units and control panels shall be tested and labeled by a NRTL in accordance with a suitable applicable nationally recognized standard.

B. Pressure Relief Port:

C. Pressure relief ports shall be utilized for all rooms operating at a temperature of -17.8°C (0°F) or below. The relief port shall be provided to equalize the difference in exterior and interior pressure caused by sudden temperature changes. The relief port shall be heated to prevent freezing.

D. Refrigeration system:

1. All rooms shall be provided with mechanical cooling system as specified herein. The refrigeration system shall be an integral part of the control and conditioning system. Condensing unit shall be remotely located on building roof. All piping and wiring between remote components and rooms shall be installed by the manufacturer. Coordinate final connections to building services with plumbing, mechanical and electrical contractors.

a. The compressor condensing unit shall consist of a water-cooled accessible semi-hermetic compressor. Include all components necessary to accomplish effective, efficient, serviceable installation. System shall consist of, but not limited to,

accessible semi-hermetic compressor, receiver, condenser, evaporator, moisture indicating sight glass, liquid filter-drier, high and low pressure controls, crankcase pressure regulator, suction accumulator, suction line filter, expansion valve, oil level, sight glass, condenser pressure regulator, manual shut-off valves and all interconnecting piping, insulation and wiring. Unit shall be designed for continuous operation for maximum compressor life.

b. System capacity control shall be accomplished thru the use of a modulating hot gas valve which continuously mixes the liquid and hot gas phase of the refrigerant to achieve the selected performance of the system.
c. Condensing units shall be provided with manual reset high and low pressure controls.
d. Provide solenoid valves for operation with a manual pump down switch included with the main control panel. No solenoid valve shall be utilized for the normal operation of the refrigeration system.
e. Ceiling Conditioning Unit: The air in the room shall be conditioned by a custom ceiling mounted conditioning unit. It shall contain all interior cooling, heating, and air moving equipment within a housing fabricated of smooth aluminum. Service to the internal components shall be via removable panels on the housing. The bottom of the housing shall serve as a condensate drain pan. The conditioning unit shall be completely pre-assembled, and tested prior to shipment, requiring only field connection to controller and condensing units.
f. Air movers shall have permanently lubricated motors. Evaporator coil shall be fabricated of copper tubes and aluminum fins. Suspend unit from roof-ceiling panels.
g. Condensate drain pan shall be heated on all units with operating temperature range extending below 0°C.
h. There will be perforated false walls running front to back on each side of the chamber. Air flow shall be discharged down the center of the chamber and drawn across the shelving tiers into the perforated side-walls.

2.6 ACCESSORIES

A. Penetrations for Pipe and Conduit through Panels:

1. Provide for each penetration through room's walls and roof-ceiling.
2. Seal penetrations, from both ends with silicone sealant, to prevent air infiltration into room and insulate to prevent condensation at pipes, conduit, and junction boxes.

2.7 CONTROLS

A. Control Console

1. A control console incorporating a key locked door with a clear acrylic window shall be required for viewing and protecting the settable controls. The console shall be mounted on the controlled environment room exterior next to the door if possible. All controls, switches, pilot lights, alarms and temperature recorder shall be housed in a painted aluminum control console.
2. All ungrounded conductors in the control panel and their field wired extensions shall be uniquely numbered at each end with a suitably applied label. The labels shall be permanent and machine printed. Hand marking of conductors or application of tapes with hand written markings will not be accepted.
3. Control panel components shall be assigned a name, tag, or other identifier which shall be utilized throughout the system documentation to describe or refer to that component.

4. Complete control panel assembly shall be tested and certified by a NRTL to be in accordance with NFPA 70 and NFPA 79. A certifying label from the testing agency shall be applied to the exterior of each control panel.

B. Temperature Controller:

1. Temperature control shall be through a solid state microprocessor based digital control with RTD sensing. The control components shall control capacity of the refrigeration/conditioning system and be designed to meet the performance criteria of the room. Setpoint shall be through the digital control and readout shall be in degrees C & F. The controller shall have (2) closed looped channels and eight (8) open loop channels. Four (4) of the open looped channels will be used for controlling the shelf mounted lamps.

C. High/Low Temperature Safety Alarms:

1. Separate adjustable mechanical alarm thermostats shall be provided and located immediately inside each chamber door approximately seven feet AFF. These independent alarms shall shutdown all heat producing devices within the chamber whenever they are activated. The refrigeration system will shutdown in either a high temperature or a low temperature alarm condition. Once the cause of the failure has been determined and corrected the chamber will require a manual restart.

D. Defrost Control:

1. Defrost controls shall be installed on all rooms with specified operating temperature extending below +6°C. Cycle shall consist of controlled heating and then cooling of the evaporator coil, removing any accumulated frost while minimizing the impact on room performance. All rooms shall be defrosted with compressor discharge gas. Defrost cycle control shall be considered an essential element of room operation.

E. Recorder:

1. Provide a solid state temperature recorder with a seven day or twenty-four hour chart movement which is switch selectable. The recorder shall utilize a 10 inch circular chart. Provide a second pen for recording of RH levels with the room. The thermometer shall be calibrated below and above the operating range of the room and the hygrometer shall be calibrated over the range of 10% to 98%. Recorder accuracy shall be 1% full scale.

2.8 MECHANICAL DESIGN

A. Fresh Air Exchange:
Controlled environment rooms shall be provided with inlet and outlet connections for fresh air supply and exhaust. Air flow rate shall be 30 CFM, and shall be continuous.

B. Humidification:
These rooms shall utilize independent ultra sonic humidifiers.

C. Dehumidification:

1. These rooms shall be equipped with a separate humidification coil mounted immediately adjacent to the main evaporator coil. The dehumidification coil shall permit operation down to a 10ºC dewpoint with no greater than a 10ºC depression between the dewpoint and dry bulb temperature.

2.9 SPECIAL REQUIREMENTS

A. Shelf Lit Rooms

1. Multi
2. Temperature Range: +15°C to + 40°C
3. Fresh Air Volume: 30 CFM
4. Relative Humidity: 50% TO 90% WITH 10ºC DP Limit
5. Number of people working in room at one time: 2
6. Door openings: Personnel entering and leaving the room at a rate of 6 openings per hour
7. Special Requirements:

   a. Lighted Shelves

2.10 REACH-IN GROWTH CHAMBER UNIT

A. Woodless construction using CFC free insulation (overall wall thickness is 2” (5.1 cm), ample insulation for maintenance of stated temperature range).

B. Temperature Range: +10°C to + 44°C with lights on, and +2°C to + 44°C (± 0.5°C) with lights off.

C. Adjustable high and low temperature controls, audible alarms, and visual indicators shall be provided.

D. Controls shut down all power to the chamber, activating alarms (when the temperature returns to the normal range the system will automatically reset).

E. Humidity Control: Additive humidity control of higher than ambient to 60% (±10%) with lights on for set temperatures between 15°C to 30°C. Humidity control of higher than ambient to 90% (±10%) with lights off for set temperatures between 15°C to 30°C.

F. Door openings: One door opening 29.2” x 57.5” (74 cm x 146 cm) shall be provided for full access to the chamber interior.

G. Special Requirements: One tier of white epoxy coated steel wire shelving (shelf is 27”D x 28.8”W (68.6 cm x 73 cm).

H. Acceptable manufacturers:
1. Percival Scientific, Inc., Perry, IA.
2. Environmental Specialties Inc., Raleigh, NC
3. Conviron, Winnipeg, Canada

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions and proceed with work in accordance with specifications

B. Verify that utility connections are in place and correctly positioned

C. Verify that rough-in frames, anchors, and supports are accurately placed

D. Correct unsatisfactory conditions

E. Start of work constitutes acceptance of responsibility for performance.

3.2 INSTALLATION

A. Install in accordance with manufacturer's printed instructions and approved shop drawings.

B. Follow manufacturer’s printed instructions or drawings in all cases where items or details are not indicated.

C. Except for final connection, installation of each item shall be complete in every respect.

D. Provide all controls, regulating devices and all other accessories necessary for proper operation and maintenance of equipment including, but not necessarily limited to, pressure reducing valves, strainers, steam traps, control valves, relief valves, etc.

E. Include all accessories whether or not they are specifically indicated

F. Field wire electrical devices to a single point for each voltage for connection to outside power supply and monitoring devices.

G. Install alarm wiring and Ethernet wiring.

H. Closure Panels: Provide where space exists between environmental growth chambers and building's walls, columns, and ceiling.

I. Install growth chambers plumb, level, square, and free from warp or twist while maintaining dimensional tolerances and alignment with surrounding construction and adjacent surfaces.

J. Repair or replace damaged, stained or rejected work

K. Test and adjust all items of equipment for satisfactory operation

L. Interface With Other Work:

1. Coordinate with Division 22:

   a. Sizing and location of condenser-to-evaporator or piping
2. Coordinate with Division 26:

   a. Location of power connection to outside power supply.
   b. Remote monitoring devices.
   c. Wiring for controls between evaporator and condenser.
3. Penetrations for Pipe and Conduit through Panels:

   a. Coordinate with respective trades.
   b. Seal penetrations to prevent air infiltration and condensation.

3.3 ADJUSTING

A. Adjust parts for smooth, uniform operation.

3.4 CLEANING

A. Clean as required by manufacturer. Do not use materials and methods which may damage finish and surrounding construction.

3.5 DEMONSTRATION

A. Provide system demonstration at mutually agreed upon time to Owner.

B. Demonstrate refrigeration system maintenance control and alarm operations.

3.6 PROTECTION

A. Protect finished work in accordance with Division 1.

END OF SECTION 132420

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Machine-room-less electric traction passenger elevator.
2. Machine-room-less electric traction freight elevator.

B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 03 30 00 - CAST-IN-PLACE CONCRETE for lintels, sleeves, anchors, inserts, plates and similar items for elevators.
2. Section 04 20 00 - UNIT MASONRY for elevator rail bracket inserts.
3. Section 05 50 00 - METAL FABRICATIONS for miscellaneous framing and supports for hoisting machines, and for elevator door sills, cants in hoistways made from sheet steel, and elevator pit ladders.
4. Section 05 12 00 - STRUCTURAL STEEL FRAMING for the hoist beams, attachment plates, angle brackets, and other preparation of structural steel for fastening guide-rail brackets.
5. Division 26 - ELECTRICAL for telephone service to elevators.
6. Division 26 - ELECTRICAL for electrical service for elevators to and including disconnect switches at machine room door and telephone wiring to elevator.

1.3 DEFINITIONS

A. Definitions in ASME A17.1 apply to work of this Section.

B. Defective Elevator Work: Operation or control system failures; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; the need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.

1.4 SUBMITTALS

A. Product Data: Include capacities, sizes, performances, operations, safety features, finishes, and similar information. Include product data for the following:

1. Car enclosures and hoistway entrances.
2. Operation, control, and signal systems.

B. Shop Drawings: Show plans, elevations, sections, and large-scale details indicating service at each landing, equipment layout, coordination with building structure, relationships with other construction, and locations of equipment and signals. Include large-scale layout of car control station and standby power operation control panel. Indicate variations from specified requirements, maximum dynamic and static loads imposed on building structure at points of support, and maximum and average power demands.

C. Samples for Verification: For exposed finishes of cars, hoistway doors and frames, and signal equipment; 3-inch-square Samples of sheet materials; and 4-inch lengths of running trim members.

D. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoistway, pit, and machine room layout and dimensions, as shown on Drawings, and electrical service, as shown and specified, are adequate for elevator system being provided.

E. Qualification Data: For Installer.

F. Operation and Maintenance Data: For elevators to include in emergency, operation, and maintenance manuals.

G. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.

H. Warranty: Special warranty specified in this Section.

I. Continuing Maintenance Proposal: Service agreement specified in this Section.

J. State of Connecticut Elevator Agreement: See form at tend of this Section.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Elevator manufacturer or manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Source Limitations: Obtain elevators through one source from a single manufacturer.

1. Provide major elevator components, including driving machines, controllers, signal fixtures, door operators, car frames, cabs, and entrances, manufactured by a single manufacturer.

C. Regulatory Requirements: Comply with ASME A17.1 and Connecticut Elevator Code.

D. Accessibility Requirements: Comply with Section 4.10 in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), and Connecticut Building Code.

E. Fire-Rated Hoistway Entrance Assemblies: Door and frame assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to

authorities having jurisdiction, for fire-protection ratings indicated, based on testing at as close to neutral pressure as possible according to NFPA 252.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle materials, components, and equipment in manufacturer's protective packaging.

B. Store materials, components, and equipment off of ground, under cover, and in a dry location. Handle according to manufacturer's written recommendations to prevent damage, deterioration, or soiling.

1.7 COORDINATION

A. Coordinate installation of sleeves, block outs, and items that are embedded in concrete or masonry for elevator equipment. Furnish templates and installation instructions and deliver to Project site in time for installation.

B. Coordinate sequence of elevator installation with other work to avoid delaying the Work.

C. Coordinate locations and dimensions of other work relating to hydraulic elevators including pit ladders, sumps, and floor drains in pits; entrance subsills; and electrical service, electrical outlets, lights, and switches in pits and machine rooms.

1.8 WARRANTY

A. Special Manufacturer's Warranty: Manufacturer's standard form in which manufacturer agrees to repair, restore, or replace defective elevator work within specified warranty period.

1. Warranty Period: One year from date of Substantial Completion.

1.9 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, provide one year's full maintenance service by skilled employees of elevator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

1. Include 24-hour-per-day, 7-day-per-week emergency callback service.

B. Continuing Maintenance Proposal: Provide a continuing maintenance proposal from Installer to Owner, in the form of a standard one-year maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering electric traction elevators that may be incorporated into the Work include, but are not limited to, the following:

1. Fujitec America, Inc.
2. KONE Inc.
3. Otis Elevator Co.
4. Schindler Elevator Corp.
5. ThyssenKrupp Elevator.

B. Basis-of-Design: Gen2 by Otis.

2.2 PASSENGER ELEVATORS

A. Elevator:

1. Type: Machine-room-less, gearless traction.
2. Rated Load: 3500 lb
3. Rated Speed: 200 fpm
4. Operation System: Selective collective automatic operation.
5. Auxiliary Operations:

a. Standby power operation.
b. Standby powered lowering.
c. Battery-powered lowering.
d. Independent service.
e. Loaded-car bypass.
f. Automatic dispatching of loaded car.
g. Nuisance call cancel.

6. Car Enclosures: As follows:

a. Inside Width: As indicated on the Drawings.
b. Inside Depth: As indicated on the Drawings.
c. Inside Height: As indicated on the Drawings.
d. Front Walls: Satin stainless steel with integral car door frames.
e. Car Fixtures: Satin stainless steel.
f. Side and Rear Wall Panels: Plastic laminate.
g. Reveals: Satin stainless steel.
h. Door Faces (Interior): Satin stainless steel.
i. Door Sills: Aluminum.
j. Ceiling: Polished stainless steel.
k. Handrails: Satin stainless steel, at side and rear walls.
l. Floor prepared to receive carpet specified in Section 09 68 20 - SHEET CARPETING.

7. Hoistway Entrances: As follows:

a. Width: As indicated on the Drawings
b. Height: As indicated on the Drawings.
c. Type: Single-speed side sliding.
d. Frames: Satin stainless steel.
e. Doors: Satin stainless steel.
f. Sills: Aluminum.

8. Hall Fixtures: Satin stainless steel.
9. Additional Requirements: As follows:

a. Provide inspection certificate in each car, mounted under acrylic cover with satin stainless-steel frame.
b. Provide protective blanket hooks in all cars and two complete sets of full-height blankets.

2.3 FREIGHT ELEVATORS

A. Elevator:

1. Type: Machine-room-less, gearless traction.
2. Rated Load: 5000 lb.
3. Freight Loading Class: Class A.
4. Rated Speed (Up): 200 fpm.
5. Operational Speed (Down): Same as rated speed (up).
6. Auxiliary Operations: Standby powered lowering, Keyswitch feature, Card-reader operation, and Load-weighing device.
7. Signal Equipment: Satin stainless-steel, single-button hall stations with position indicator.
8. Car Enclosures: As follows:

a. Platform Width: As indicated on the Drawings.
b. Platform Depth: As indicated on the Drawings.
c. Ceiling Height: 96 inches
d. Walls and Ceiling: Satin stainless steel.
e. Floor: Rolled steel floor plate.
f. Door Type: Two-speed side sliding.
g. Car Gate Operation: Power operated.
h. Car Gate Material: Satin stainless steel.
i. Car Sill: Steel angle.
j. Lighting: 48-inch suspended 2-tube fluorescent light fixtures with white reflectors.

9. Hoistway Entrances: As follows:

a. Width: As indicated on the Drawings.
b. Height: As indicated on the Drawings.
c. Door Type: Two-speed side sliding.
d. Door Operation: Power operated.
e. Door Material: Stainless]steel.
f. Sills specified in Section 05 50 00 - METAL FABRICATIONS.

10. Additional Requirements: As follows:

a. Door reopening device.

2.4 SYSTEMS AND COMPONENTS

A. General: Provide manufacturer's standard elevator systems. Where components are not otherwise indicated, provide standard components published by manufacturer as included in standard preengineered elevator systems and as required for complete system.

B. Elevator Machines: Provide variable-voltage, variable-frequency, ac-type or variable-voltage, dc-type hoisting machines. Provide solid-state power converters.

1. Provide regenerative or nonregenerative system.
2. Limit total harmonic distortion of regenerated power to 5 percent per IEEE 519.
3. Provide means for absorbing regenerated power when elevator system is operating on standby power.
4. Provide line filters or chokes to prevent electrical peaks or spikes from feeding back into building power system.

C. Fluid for Oil Buffers: If oil buffers are used, use only fire-resistant hydraulic fluid containing antioxidant, anticorrosive, antifoaming, and metal-passivating additives.

1. Available Product: Subject to compliance with requirements, a product that may be incorporated into the Work includes, but is not limited to, "Hydro Safe (FR)" by Hydro Safe Oil Division, Inc.

D. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work where installation of devices is specified in another Section.

E. Machine Beams: Provide framing to support elevator hoisting machine and deflector sheaves from the building structure. Comply with Division 05 Section "Metal Fabrications" for materials and fabrication.

F. Car Frame and Platform: Welded steel units.

G. Guides: Provide roller guides or polymer-coated, nonlubricated sliding guides at top and bottom of car and counterweight frames.

2.5 OPERATION SYSTEMS

A. Controllers:
1. Manufacturer: Provide controllers by one of the following:
   a. Virginia Controls; Richmond, VA.
   b. Motion Control Engineering; Rancho Cordova, CA.
   c. Computerized Elevator Control Corporation; Moonachie, NJ.
2. Maintenance Features: The elevator controller shall have the following features:
   a. Universally serviceable and maintainable.
   b. Built-in diagnostics.
   c. Shall not require a proprietary tool for adjustment or maintenance.
   d. Parts shall be readily available for stock by Owner or service companies.
   e. Provide manuals and drawings related to the supplied equipment.
   f. On-board diagnostic switches and an alphanumeric display to provide user friendly interaction between the mechanic and the controller.

g. On-board event log shall store and display time-stamped events for diagnostic purposes.
h. Extensive diagnostic capability, including a built-in LCD display or equivalent to allow access to major user functions and diagnostic features. The display shall be a multi-character, multi-line type with associated keypad to allow users to enter information. The display shall show data and menus in readily understood character format. No numeric, hexadecimal, or binary codes will be accepted.

3. Provide a programmable car fan and light timer programmed for opertion. When the set tie expires, the fan and light of an idle car shall shut off to conserve energy. Demand for elevator shall immediately cause the fan and light to activate.

B. Single-Car Auxiliary Operations: In addition to primary operation system features, provide the following operational features for elevators where indicated:

1. Standby Power Operation: On activation of standby power, car is returned to a designated floor and parked with doors open. Car can be manually put in service on standby power, either for return operation or for regular operation, by switches in control panel located at main lobby. Manual operation causes automatic operation to cease.
2. Nuisance Call Cancel: When car calls exceed a preset number while car load is less than a predetermined weight, all car calls are canceled. Preset number of calls and predetermined weight can be adjusted.

C. Security Features: Provide the following security features, where indicated. Security features shall not affect emergency firefighters' service.

1. Card-Reader Operation: System uses card readers at car control stations to authorize calls. Security system determines which landings and at what times calls require authorization by card reader. Provide required conductors in traveling cable and panel in machine room for interconnecting card readers, other security access system equipment, and elevator controllers. Provide stripe-swipe card reader integral with each car control station.
2. Keyswitch Operation: Push buttons are activated and deactivated by security keyswitches at car control stations. Key is removable only in deactivated position.
3. Car-to-Lobby Feature: Feature, activated by keyswitch at main lobby, that causes car to return immediately to lobby and open doors for inspection. On deactivation by keyswitch, calls registered before keyswitch activation are completed and normal operation is resumed.

2.6 DOOR REOPENING DEVICES

A. Infrared Array: Provide door reopening devices with uniform array of 36 or more microprocessor-controlled, infrared light beams projecting across car entrance. Interruption of one or more of the light beams shall cause doors to stop and reopen.

2.7 FINISH MATERIALS

A. General: Provide the following materials for exposed parts of elevator car enclosures, car doors, hoistway entrance doors and frames, and signal equipment as indicated.

B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, commercial steel, Type B, exposed, matte finish.

C. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, commercial steel, Type B, pickled.

D. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.

1. Textured Stainless-Steel Sheet: Product with embossed texture rolled into exposed surface.

E. Stainless-Steel Tubing: ASTM A 554, Grade MT 304.

F. Nickel Silver Extrusions: ASTM B 151/B 151M, Alloy UNS No. C74500 or No. C77600.

2.8 CAR ENCLOSURES

A. General: Provide enameled-steel car enclosures to receive removable wall panels, with removable car roof, access doors, power door operators, and ventilation.

1. Provide standard railings complying with ASME A17.1 on car tops where required by ASME A17.1.
2. Provide finished car including materials and finishes specified below.

B. Materials and Finishes: Provide manufacturer's standards, but not less than the following:

1. Subfloor: Underlayment grade, exterior plywood, 5/8-inch nominal thickness.
2. Fabricate car with recesses and cutouts for signal equipment.
3. Fabricate car door frame integrally with front wall of car.
4. Stainless-Steel Doors: Flush, hollow-metal construction; fabricated from stainless-steel sheet.
5. Sight Guards: Provide sight guards on car doors.
6. Sills: Extruded nickel silver, with grooved surface, 1/4 inch thick.
7. Handrails: Manufacturer's standard handrails meeting code requirements, of shape, metal, and finish indicated.

2.9 HOISTWAY ENTRANCES

A. General: Provide manufacturer's standard horizontal-sliding, door-and-frame hoistway entrances complete with track systems, hardware, sills, and accessories. Provide frame size and profile to coordinate with hoistway wall construction.

1. Where gypsum board wall construction is indicated, provide self-supporting frames with reinforced head sections.

B. Materials and Fabrication: Provide manufacturer's standards, but not less than the following:

1. Stainless-Steel Frames: Formed from stainless-steel sheet.
2. Sight Guards: Provide sight guards on doors matching door edges.
3. Sills: Extruded metal, with grooved surface, 1/4 inch thick.
4. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107.

2.10 SIGNAL EQUIPMENT

A. General: Provide hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Fabricate lighted elements with long-life incandescent lamps and acrylic or other permanent, nonyellowing translucent plastic diffusers or LEDs.

B. Car Control Stations: Provide manufacturer's standard recessed car control stations. Mount in return panel adjacent to car door, unless otherwise indicated.

C. Emergency Communication System: Provide system that complies with ASME A17.1 and the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)." On activation, system dials preprogrammed number of monitoring station and identifies elevator location to monitoring station. System provides two-way voice communication without using a handset and provides visible signals that indicate when system has been activated and when monitoring station has responded. System is contained in flush-mounted cabinet, with identification, instructions for use, and battery backup power supply.

D. Firefighters' Two-Way Telephone Communication Service: Provide flush-mounted cabinet in each car and required conductors in traveling cable for firefighters' two-way telephone communication service specified in Division 26 - ELECTRICAL.

E. Car Position Indicator: Provide illuminated, digital-type car position indicator, located above car door or above car control station. Also provide audible signal to indicate to passengers that car is either stopping at or passing each of the floors served.

1. Include travel direction arrows if not provided in car control station.

F. Hall Push-Button Stations: Provide one hall push-button station at each landing for each single elevator or group of elevators, but not less than one station for each four elevators in a group.

G. Hall Lanterns: Units with illuminated arrows; but provide single arrow at terminal landings. Provide[one of] the following:

1. Manufacturer's standard wall-mounted units, for mounting above entrance frames.

H. Hall Annunciator: With each hall lantern, provide audible signals indicating car arrival and direction of travel. Signals sound once for up and twice for down.

1. At manufacturer's option, audible signals may be placed on each car.

I. Corridor Call Station Pictograph Signs: Provide signs matching hall push-button stations, with text and graphics as required by authorities having jurisdiction, indicating that in case of fire elevators are out of service and exits should be used instead. Provide one sign at each hall push-button station, unless otherwise indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elevator areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance. Examine hoistways, hoistway openings, pits, and machine rooms as constructed; verify critical dimensions; and examine supporting structure and other conditions under which elevator work is to be installed.

1. For the record, prepare a written report, endorsed by Installer, listing dimensional discrepancies and conditions detrimental to performance or indicating that dimensions and conditions were found to be satisfactory.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions.

B. Welded Construction: Provide welded connections for installing elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship and for qualifications of welding operators.

C. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts designed to minimize transmission of vibrations to structure and thereby minimize structure-borne noise from elevator system.

D. Lubricate operating parts of systems, including ropes, as recommended by manufacturers.

E. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with car. Where possible, delay final adjustment of sills and doors until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.

F. Leveling Tolerance: 1/8 inch, up or down, regardless of load and direction of travel.

G. Set sills flush with finished floor surface at landing. Fill space under sill solidly with nonshrink, nonmetallic grout.

H. Locate hall signal equipment for elevators as follows, unless otherwise indicated:

1. For groups of elevators, locate hall push-button stations between two elevators at center of group or at location most convenient for approaching passengers.
2. Place hall lanterns either above or beside each hoistway entrance.
3. Mount hall lanterns at a minimum of 72 inches above finished floor.

3.3 FIELD QUALITY CONTROL

A. Acceptance Testing: On completion of elevator installation and before permitting use (either temporary or permanent) of elevators, perform acceptance tests as required and recommended by ASME A17.1 and by governing regulations and agencies.

B. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times tests are to be performed on elevators.

3.4 PROTECTION

A. Temporary Use: Limit temporary use for construction purposes to one elevator. Comply with the following requirements for each elevator used for construction purposes:

1. Provide car with temporary enclosure, either within finished car or in place of finished car, to protect finishes from damage.
2. Provide strippable protective film on entrance and car doors and frames.
3. Provide padded wood bumpers on entrance door frames covering jambs and frame faces.
4. Provide other protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.
5. Do not load elevators beyond their rated weight capacity.
6. Engage elevator Installer to provide full maintenance service. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as necessary for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.
7. Engage elevator Installer to restore damaged work, if any, so no evidence remains of correction. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate elevator.

B. Check operation of each elevator with Owner's personnel present and before date of Substantial Completion. Determine that operation systems and devices are functioning properly.

END OF SECTION 14 21 00

AGREEMENT

It is hereby agreed on this _____ day of _____, _____ between the State of Connecticut, Department of Construction Services acting through its Commissioner, _____ and _____ acting through _____ its _____ that:

WHEREAS, the State of Connecticut owns several buildings which contain elevators manufactured by _____;

WHEREAS, _____ Provides a diagnostic device required for the complete service and maintenance of the elevators which diagnostic device has a six (6) month expiration date;

WHEREAS, the State of Connecticut retains several contractors and/or uses its own employees to service the _____ elevators;

WHEREAS, the State of Connecticut finds any expiration period an excessive burden on the service and maintenance of the elevators;

NOW, THEREFORE, for good and sufficient consideration of $1.00 (one dollar) the parties agree as follows:

1. **_____ shall provide the State of Connecticut with the proper diagnostic devices to service all _____, Inc. elevators in all state buildings at no cost to the State of Connecticut.**

2. **The diagnostic devices shall not contain an expiration date or the use of any proprietary restraint and will be capable of servicing and maintaining the elevators for their life.**

3. **In the event _____ deems it necessary to update the diagnostic devices it shall exchange such devices at no cost to the State of Connecticut. The updated diagnostic devices shall not contain an expiration date and will be capable of servicing and maintaining the elevators for their life. This upgrade will occur prior to previous tools date of expiration.**

4. **All employees of the State of Connecticut duly qualified or licensed and any contractors retained by the State of Connecticut to service and/or maintain the _____ elevators shall use the diagnostic devices solely for the purpose of conducting normal service and maintenance activities.**

5. **All employees of the State of Connecticut duly qualified or licensed and any contractors retained by the State of Connecticut to service and/or maintain the _____ elevators shall not themselves or otherwise give, lend, sell, advertise, transfer or permit access to or the use of the diagnostic devices, in part or whole, in any manner by any means, by any other person.**

6. **The State of Connecticut understands that the diagnostic devices are capable of programming and/or reprogramming critical equipment, operating performance functions and reprogramming critical equipment functions and parameters including safety and/or test sequences. Improper use may produce unsafe operating conditions.**

7. **The State of Connecticut agrees that _____ is not responsible for the results of the improper use, either directly or indirectly, of the diagnostic devices, unless the device is defective.**

8. **The State of Connecticut agrees to make all reasonable efforts necessary or appropriate to maintain and protect the diagnostic devices and shall promptly notify _____ in writing, of any unauthorized use, possession, loss or theft of the diagnostic devices in part or whole.**

9. **This Agreement shall be interpreted and enforced pursuant to the laws of the State of Connecticut in the Superior Court for the Judicial District of Hartford, at Hartford, Connecticut.**

Witness	**Donald DeFronzo** **Acting Commissioner,** **State of Connecticut** **Department of Construction Services**
Witness	_____
Witness	