EXPANSION AND ALTERATIONS TO WEST SHORE MIDDLE SCHOOL

70 KAY AVENUE
MILFORD, CT 06460

S/P+A Project No. 14.278

DATE: November 11, 2016

The following changes to the Drawings and Project Specifications shall become a part of the Drawings and Project Specifications; superseding previously issued Drawings and Project Specifications to the extent modified by Addendum No. 1.

General Information/Clarifications:

- Wage Rates: Attached as part of this Addendum. (15 pages)
- Pre-Bid Sign in Sheet. (5 pages)
- RFI'S: Attached as part of this Addendum.
- Clarification: The BIM model for this project is available to all Bidding General Contractors upon signing of all waivers, releases, etc. Method of distribution of BIM model to be determined.

New Specifications Added (attached as part of this Addendum):

- SECTION 238216 "Hydronic Air Coils". (3 pages)
- SECTION 238236 "Finned-Tube Radiation Heaters". (4 pages)
- SECTION 238239 "Heating Terminal Units". (7 pages)

Changes to the Specifications:

- DELETE: The following Specification Sections in their entirety:
    - 230529 "Hangers and Supports for HVAC Piping and Equipment".
    - 230900 "Instrumentation and Control for HVAC".
    - 230993 "Sequence of Operations for HVAC Controls".
    - 233113 "Metal Ducts".
    - 233300 "Air Duct Accessories".
    - 235216 "Condensing Boiler".
    - 237416 "Packaged Rooftop Air Conditioning Units".
    - 237433 "Dedicated Outdoor Air Units".
    - 275116 "Public Address System".
- ADD: The following **Revised** Specification Sections in their entirety, attached as part of this

Addendum:

- 230529 “Hangers and Supports for HVAC Piping and Equipment”. (12 pages)
- 230900 “Instrumentation and Control for HVAC”. (48 pages)
- 230993 “Sequence of Operations for HVAC Controls”. (14 pages)
- 233113 “Metal Ducts”. (18 pages)
- 233300 “Air Duct Accessories”. (16 pages)
- 235216 “Condensing Boiler”. (8 pages)
- 237416 “Packaged Rooftop Air Conditioning Units”. (16 pages)
- 237433 “Dedicated Outdoor Air Units”. (11 pages)
- 275116 “Public Address System”. (25 pages)

- SUPPLEMENTARY INSTRUCTIONS TO BIDDERS, PAGE 1:
  DELETE: “Due Date for RFI’s is 5:00 pm, November 30, 2016. Last Addendum will be issued by 5:00 pm, December 2, 2016.”

- SECTION 042000 “UNIT MASONRY”/2.4/C/8: Revise “Color and Texture at New Facades: As selected by Architect and Owner from manufacturer’s full range” to read “Colors 1, 2, or 3 as indicated on Drawings. Texture as selected by Architect and Owner from manufacturer’s full range.”

- SECTION 042000 “UNIT MASONRY”/2.4/C/9: Revise “Color and Texture for Patching Existing Facades: As selected by Architect and Owner from manufacturer’s full range” to read “Colors 1, 2, or 3 as indicated on Drawings. Texture to match existing.”

- SECTION 055000 “METAL FABRICATIONS”/1.2/C/4:
  ADD: Section 099113 “Exterior Painting” for zinc-rich coatings for refinishing existing steel lintels.

- SECTION 099113 “EXTERIOR PAINTING”/3.6/:
  ADD: C. Steel and Iron Substrates:

  1. Solvent-Based Light Industrial Coating System:

     a. Prime Coat: Primer, zinc-rich, anti-corrosive for metal.

        1) **Zinc-It**, instant cold galvanize coating system, used as galvanized substrate for finish paint systems.

- SECTION 099113 “EXTERIOR PAINTING”/1.2/A:
  ADD: 5. Steel.

- SECTION 055813 “COLUMN COVERS”/2.1/C/1/a: Revise “Finish: Mill brushed” to read “Finish: Kynar 500.”

- SECTION 090000 "SCHEDULE OF FINISHES"/FLOORS:
  ADD:
  - **WOM-3**
  - **Item:** Roll-Up Entrance Mat
  - **Manufacturer:** Mats, Inc
  - **Style:** Supreme Nop
  - **Color:** 88 Black Walnut
  - **Size:** 6'-7''W Roll Size, Lengths vary
  - **Thickness:** ½ inch
  - **Note:** Loose Lay; Refer to Finish & Floor Pattern Plans for Sizes, Refer to Section 124813
  - **Local Rep:** 800.MATS.INC

- SECTION 124813 "ENTRANCE FLOOR MATS AND FRAMES":

  ADD: 2.3 ENTRANCE MATS (**WOM-3**)

  A. Basis-of-Design Product:

     1. Mats Inc.; As indicated in Section 090000 "Schedule of Finishes".

  B. 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. Pawling Corporation; Architectural Products Division.
     2. Substitutions: Under provisions of Section 012500 "Substitution Procedures".

  C. Surface-Mount Roll-Up Carpet-Type Mats: One hundred percent (100%) nylon fiber.

     1. Thickness and Color: As indicated in Section 090000 "Schedule of Finishes".

  D. Performance Characteristics: As follows:

     1. Electrostatic Propensity: Less than 2.0 kV according to EN 815.

- SECTION 081113 "HOLLOW METAL DOORS AND FRAMES"/**2.3 Interior Hollow-Metal Doors and Frames**:

  ADD: C. Heavy-Duty Doors and Frames: SDI A250.8, Level 2. Doors P1.2 (single leaf) and P1.3 (double leaf), locations as indicated on Drawing A06.1 "Construction Phasing Plans Phase One, January 2017.

  1. Physical Performance: Level B according to SDI A250.4.
  2. Doors:

     a. Type: Flush, solid (no vision panel).
     b. Thickness: 1-3/4 inches (44.5 mm).

c. Face: Uncoated cold-rolled steel sheet, minimum thickness of 0.042 inch (1.0 mm).
d. Edge Construction: Model 2, Seamless.
e. Core: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core at manufacturer's discretion.
f. Core: Vertical steel stiffener.

3. Frames:

a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch (1.3 mm).
b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
c. Construction: Knocked down.

4. Exposed Finish: Prime.

5. Fire Rating: One hour.

- SECTION 081113 "HOLLOW METAL DOORS AND FRAMES"/**2.4 Exterior Hollow-Metal Doors and Frames**:

ADD: C. Extra-Heavy-Duty Doors and Frames: SDI A250.8, Level 3. Double Leaf Door P1.1, location as indicated on Drawing A06.1 "Construction Phasing Plans Phase One, January 2017.

1. Physical Performance: Level A according to SDI A250.4.
2. Doors:

a. Type: Flush, solid (no vision panel).
b. Thickness: 1-3/4 inches (44.5 mm.)
c. Face: Metallic-coated steel sheet, minimum thickness of 0.053-inch (1.3 mm), with minimum A40 (ZF120) coating.
d. Edge Construction: Model 2, Seamless.
e. Core: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core at manufacturer's discretion.
f. Core: Vertical steel stiffener.

1) Thermal-Rated Doors: Provide doors fabricated with thermal-resistance value (R-value) of not less than 2.1 deg F x h x sq. ft./Btu (0.370 K x sq. m/W) when tested according to ASTM C 1363.

3. Frames:

g. Materials: Metallic-coated steel sheet, minimum thickness of 0.053-inch (1.3 mm), with minimum A40 (ZF120) coating.
h. Construction: Knocked down.

4. Exposed Finish: Prime Factory.

5. Fire Rating: One hour.

- SECTION 087100 "DOOR HARDWARE"/3.6 DOOR HARDWARE SCHEDULE:

ADD: **HW-29:** NEW CONSTRUCTION PHASE 1 - DOUBLE LEAF DOORS: P1.1, P1.3.

EACH PAIR TO HAVE:
2 CONTINUOUS HINGES
2 EXIT DEVICE W/ CYLINDER/POSITIVE LATCHING
1 LEVER
2 DELAYED ACTION CLOSER
2 KICKPLATE
2 ACCESSIBLE THRESHOLD
1 REMOVABLE MULLION
SILENCERS

LOCKSETS
EXIT: P1.1, P1.3.

ADD: **HW-30:** NEW CONSTRUCTION PHASE 1 SINGLE LEAF DOOR: P1.2.

EACH TO HAVE:
3 BUTT HINGES
1 BORED CYLINDER
1 LEVER SET W/POSITIVE LATCHING
1 DELAYED ACTION CLOSER
1 KICKPLATE
1 ACCESSIBLE THRESHOLD
SILENCERS

LOCKSETS
SECURITY CLASSROOM: P1.2.

New Drawings: (Not Applicable)

Changes to the Drawings:

DELETE: The following Drawings in their entirety:

A06.1 Construction Phasing Plans Phase One, January 2017, dated 8/18/2016
A06.2 Construction Phasing Plans Phase Two, dated 8/18/2016
A101 First Floor Plan Part A, dated 8/18/2016
A103 First Floor Plan Part C, dated 8/18/2016
A110 Overall Roof Plan, dated 8/18/2016
A111 Partial Roof Plan Part A, dated 8/18/2016

A112 Partial Roof Plan Part B, dated 8/18/2016
A113 Partial Roof Plan Part C, dated 8/18/2016
A114 Partial Roof Plan Part D, dated 8/18/2016
A115 Roof Details, dated 8/18/2016
A183 Plan Details Part B, dated 8/18/2016
A186 Plan Details Part 'B' and 'C', dated 8/18/2016
A260 First Floor Finish and Floor Pattern Plan – Part A, dated 8/18/2016
A261 First Floor Finish and Floor Pattern Plan – Part B, dated 8/18/2016
A301 Partial Exterior Elevations, dated 8/18/2016
A302 Partial Exterior Elevations, dated 8/18/2016
A304 Partial Exterior Elevations, dated 8/18/2016
A311 Window Elevations, dated 8/18/2016
A312 Window Elevations, dated 8/18/2016
A316 Window Details, dated 8/18/2016
A317 Window Details, dated 8/18/2016
A319 Window Details, dated 8/18/2016
A715 Interior Elevations – Part B Gymnasium, dated 8/18/2016
A719 Interior Elevations – Part C Learning Center, dated 8/18/2016
A720 Interior Elevations – Part C Learning Center & Staff Lounge dated 8/18/2016
A801 Casework Details, dated 8/18/2016
A910 Door Schedule, dated 8/18/2016
FP101 First Floor – Area A Fire Protection Plan, dated 8/18/2016
P111 Main Level Demo Plan - Area A, dated 8/18/2016
P113 Main Level Demo Plan - Area C, dated 8/18/2016
P201 Tunnel Plumbing Plan - Area A, dated 8/18/2016
P202 Tunnel Plumbing Plan - Area B, dated 8/18/2016
P203 Tunnel Plumbing Plan - Area C, dated 8/18/2016
P211 Main Level Plumbing Plan - Area A, dated 8/18/2016
P212 Main Level Plumbing Plan - Area B, dated 8/18/2016
P213 Main Level Plumbing Plan - Area C, dated 8/18/2016
P901 Plumbing Schedules, dated 8/18/2016
MD101 Mechanical Main Level Demo Plan Area-A, dated 8/18/2016
M101 Mechanical Main Level Duct Plan Area-A, dated 8/18/2016
M102 Mechanical Main Level Duct Plan Area-B, dated 8/18/2016
M103 Mechanical Main Level Duct Plan Area-C, dated 8/18/2016
M104 Mechanical Main Level Duct Plan Area-D, dated 8/18/2016
M302 Mechanical Details, dated 8/18/2016
M303 Mechanical Details, dated 8/18/2016
M400 Mechanical Schedules, dated 8/18/2016
M402 Mechanical Schedules, dated 8/18/2016
E201 Power Plan Part A, dated 8/18/2016
E202 Power Plan Part B, dated 8/18/2016
E203 Power Plan Part C, dated 8/18/2016
E204 Power Plan Part D, dated 8/18/2016
E205 Power Upper Level Plan Part A, dated 8/18/2016
E401 Communication Details, dated 8/18/2016

ADD: The following **Revised** Drawings, attached as part of this Addendum:

A06.1 Construction Phasing Plans Phase One, January 2017, dated 11/11/2016

A06.2 Construction Phasing Plans Phase Two, dated 11/11/2016
A101 First Floor Plan Part A, dated 11/11/2016
A103 First Floor Plan Part C, dated 11/11/2016
A110 Overall Roof Plan, dated 11/11/2016
A111 Partial Roof Plan Part A, dated 11/11/2016
A112 Partial Roof Plan Part B, dated 11/11/2016
A113 Partial Roof Plan Part C, dated 11/11/2016
A114 Partial Roof Plan Part D, dated 11/11/2016
A115 Roof Details, dated 8/18/2016
A183 Plan Details Part B, dated 11/11/2016
A186 Plan Details Part 'B' and 'C', dated 11/11/2016
A260 First Floor Finish and Floor Pattern Plan – Part A, dated 11/11/2016
A261 First Floor Finish and Floor Pattern Plan – Part B, dated 11/11/2016
A301 Partial Exterior Elevations, dated 11/11/2016
A302 Partial Exterior Elevations, dated 11/11/2016
A304 Partial Exterior Elevations, dated 11/11/2016
A311 Window Elevations, dated 11/11/2016
A312 Window Elevations, dated 11/11/2016
A316 Window Details, dated 11/11/2016
A317 Window Details, dated 11/11/2016
A319 Window Details, dated 11/11/2016
A715 Interior Elevations – Part B Gymnasium, dated 11/11/2016
A719 Interior Elevations – Part C Learning Center, dated 11/11/2016
A720 Interior Elevations – Part C Learning Center & Staff Lounge, dated 11/11/2016
A801 Casework Details, dated 11/11/2016
A910 Door Schedule, dated 11/11/2016
FP101 First Floor – Area A Fire Protection Plan, dated 11/11/2016
P111 Main Level Demo Plan - Area A, dated 11/11/2016
P113 Main Level Demo Plan - Area C, dated 11/11/2016
P201 Tunnel Plumbing Plan - Area A, dated 11/11/2016
P202 Tunnel Plumbing Plan - Area B, dated 11/11/2016
P203 Tunnel Plumbing Plan - Area C, dated 11/11/2016
P211 Main Level Plumbing Plan - Area A, dated 11/11/2016
P212 Main Level Plumbing Plan - Area B, dated 11/11/2016
P213 Main Level Plumbing Plan - Area C, dated 11/11/2016
P901 Plumbing Schedules, dated 11/11/2016
MD101 Mechanical Main Level Demo Plan Area-A, dated 11/11/2016
M101 Mechanical Main Level Duct Plan Area-A, dated 11/11/2016
M102 Mechanical Main Level Duct Plan Area-B, dated 11/11/2016
M103 Mechanical Main Level Duct Plan Area-C, dated 11/11/2016
M104 Mechanical Main Level Duct Plan Area-D, dated 11/11/2016
M302 Mechanical Details, dated 11/11/2016
M303 Mechanical Details, dated 11/11/2016
M400 Mechanical Schedules, dated 11/11/2016
M402 Mechanical Schedules, dated 11/11/2016
E201 Power Plan Part A, dated 11/11/2016
E202 Power Plan Part B, dated 11/11/2016
E203 Power Plan Part C, dated 11/11/2016
E204 Power Plan Part D, dated 11/11/2016
E205 Power Upper Level Plan Part A, dated 11/11/2016
E401Communication Details, dated 11/11/2016

The bid due dates are unchanged by this Addendum.

The Addendum consists of one hundred ninety-five (195) pages of 8½" x 11" text, and 52 pages of 30" x 42" drawings.

End of Addendum #1

Minimum Rates and Classifications for Building Construction

ID# : B 22839

Connecticut Department of Labor
Wage and Workplace Standards Division

By virtue of the authority vested in the Labor Commissioner under provisions of Section 31-53 of the General Statutes of Connecticut, as amended, the following are declared to be the prevailing rates and welfare payments and will apply only where the contract is advertised for bid within 20 days of the date on which the rates are established. Any contractor or subcontractor not obligated by agreement to pay to the welfare and pension fund shall pay this amount to each employee as part of his/her hourly wages.

Project Number: Project Town: Milford

State#: FAP#:

Project: West Shore Middle School Expansion And Alteration

CLASSIFICATION	Hourly Rate	Benefits
1a) Asbestos Worker/Insulator (Includes application of insulating materials, protective coverings, coatings, & finishes to all types of mechanical systems; application of firestopping material for wall openings & penetrations in walls, floors, ceilings	35.75	28.82
1b) Asbestos/Toxic Waste Removal Laborers: Asbestos removal and encapsulation (except its removal from mechanical systems which are not to be scrapped), toxic waste removers, blasters.**See Laborers Group 7**		
1c) Asbestos Worker/Heat and Frost Insulator	37.15	27.56

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2) Boilermaker	35.24	25.01
3a) Bricklayer, Cement Mason, Concrete Finisher (including caulking), Stone Masons	33.48	29.16 + a
3b) Tile Setter	34.30	24.15
3c) Terrazzo Mechanics and Marble Setters	31.69	22.35
3d) Tile, Marble & Terrazzo Finishers	26.43	20.59
3e) Plasterer	33.48	29.16

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------LABORERS------

4) Group 1: Laborers (common or general), acetylene burners, carpenter tenders, concrete specialists, wrecking laborers, fire watchers.	28.55	18.90
4a) Group 2: Mortar mixers, plaster tender, power buggy operators, powdermen, fireproofer/mixer/nozzleman (Person running mixer and spraying fireproof only).	28.80	18.90
4b) Group 3: Jackhammer operators/pavement breaker, mason tender (brick), mason tender (cement/concrete), forklift operators and forklift operators (masonry).	29.05	18.90
4c) **Group 4: Pipelayers (Installation of water, storm drainage or sewage lines outside of the building line with P6, P7 license) (the pipelayer rate shall apply only to one or two employees of the total crew who primary task is to actually perform the mating of pipe sections) P6 and P7 rate is $26.80.	28.80	18.90
4d) Group 5: Air track operator, sand blaster and hydraulic drills.	29.30	18.90

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4e) Group 6: Blasters, nuclear and toxic waste removal.	31.55	18.90
4f) Group 7: Asbestos/lead removal and encapsulation (except it's removal from mechanical systems which are not to be scrapped).	29.55	18.90
4g) Group 8: Bottom men on open air caisson, cylindrical work and boring crew.	28.38	18.90
4h) Group 9: Top men on open air caisson, cylindrical work and boring crew.	27.86	18.90
4i) Group 10: Traffic Control Signalman	16.00	18.90
5) Carpenter, Acoustical Ceiling Installation, Soft Floor/Carpet Laying, Metal Stud Installation, Form Work and Scaffold Building, Drywall Hanging, Modular-Furniture Systems Installers, Lathers, Piledrivers, Resilient Floor Layers.	32.00	24.42

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5a) Millwrights	32.47	24.84
6) Electrical Worker (including low voltage wiring) (Trade License required: E1,2 L-5,6 C-5,6 T-1,2 L-1,2 V-1,2,7,8,9)	38.02	23.75+3% of gross wage
7a) Elevator Mechanic (Trade License required: R-1,2,5,6)	49.00	29.985+a+b
-----LINE CONSTRUCTION----		
Groundman	24.99	6.25%+11.81
Linemen/Cable Splicer	45.43	6.25%+20.70

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8) Glazier (Trade License required: FG-1,2)	35.58	20.15 + a
9) Ironworker, Ornamental, Reinforcing, Structural, and Precast Concrete Erection	35.22	31.99 + a
----OPERATORS----		
Group 1: Crane handling or erecting structural steel or stone, hoisting engineer 2 drums or over, front end loader (7 cubic yards or over), work boat 26 ft. and over and Tunnel Boring Machines. (Trade License Required)	38.55	23.55 + a
Group 2: Cranes (100 ton rate capacity and over); Excavator over 2 cubic yards; Piledriver ($3.00 premium when operator controls hammer); Bauer Drill/Caisson. (Trade License Required)	38.23	23.55 + a
Group 3: Excavator; Backhoe/Excavator under 2 cubic yards; Cranes (under 100 ton rated capacity), Grader/Blade; Master Mechanic; Hoisting Engineer (all types of equipment where a drum and cable are used to hoist or drag material regardless of motive power of operation), Rubber Tire Excavator (Drott-1085 or similar);Grader Operator; Bulldozer Fine Grade. (slopes, shaping, laser or GPS, etc.). (Trade License Required)	37.49	23.55 + a

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Group 4: Trenching Machines; Lighter Derrick; Concrete Finishing Machine; CMI Machine or Similar; Koehring Loader (Skooper).	37.10	23.55 + a
Group 5: Specialty Railroad Equipment; Asphalt Paver; Asphalt Reclaiming Machine; Line Grinder; Concrete Pumps; Drills with Self Contained Power Units; Boring Machine; Post Hole Digger; Auger; Pounder; Well Digger; Milling Machine (over 24" Mandrell)	36.51	23.55 + a
Group 5 continued: Side Boom; Combination Hoe and Loader; Directional Driller; Pile Testing Machine.	36.51	23.55 + a
Group 6: Front End Loader (3 up to 7 cubic yards); Bulldozer (rough grade dozer).	36.20	23.55 + a
Group 7: Asphalt roller, concrete saws and cutters (ride on types), vermeer concrete cutter, Stump Grinder; Scraper; Snooper; Skidder; Milling Machine (24" and under Mandrell).	35.86	23.55 + a
Group 8: Mechanic, grease truck operator, hydroblaster; barrier mover; power stone spreader; welding; work boat under 26 ft.; transfer machine.	35.46	23.55 + a

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Group 9: Front end loader (under 3 cubic yards), skid steer loader regardless of attachments, (Bobcat or Similar): forklift, power chipper; landscape equipment (including Hydroseeder).	35.03	23.55 + a
Group 10: Vibratory hammer; ice machine; diesel and air, hammer, etc.	32.99	23.55 + a
Group 11: Conveyor, earth roller, power pavement breaker (whiphammer), robot demolition equipment.	32.99	23.55 + a
Group 12: Wellpoint operator.	32.93	23.55 + a
Group 13: Compressor battery operator.	32.35	23.55 + a
Group 14: Elevator operator; tow motor operator (solid tire no rough terrain).	31.21	23.55 + a

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Group 15: Generator Operator; Compressor Operator; Pump Operator; Welding Machine Operator; Heater Operator.	30.80	23.55 + a
Group 16: Maintenance Engineer/Oiler.	30.15	23.55 + a
Group 17: Portable asphalt plant operator; portable crusher plant operator; portable concrete plant operator.	34.46	23.55 + a
Group 18: Power safety boat; vacuum truck; zim mixer; sweeper; (Minimum for any job requiring a CDL license).	32.04	23.55 + a
------PAINTERS (Including Drywall Finishing)------		
10a) Brush and Roller	32.02	20.15

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10b) Taping Only/Drywall Finishing	32.77	20.15
10c) Paperhanger and Red Label	32.52	20.15
10e) Blast and Spray	35.02	20.15
11) Plumber (excluding HVAC pipe installation) (Trade License required: P-1,2,6,7,8,9 J-1,2,3,4 SP-1,2)	40.62	29.71
12) Well Digger, Pile Testing Machine	33.01	19.40 + a
Roofer: Cole Tar Pitch	40.00	15.00 + a

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Roofer: Slate, Tile, Composition, Shingles, Singly Ply and Damp/Waterproofing	38.50	15.00 + a
15) Sheetmetal Worker (Trade License required for HVAC and Ductwork: SM-1,SM-2,SM-3,SM-4,SM-5,SM-6)	36.00	34.51
16) Pipefitter (Including HVAC work) (Trade License required: S-1,2,3,4,5,6,7,8 B-1,2,3,4 D-1,2,3,4, G-1, G-2, G-8 & G-9)	40.62	29.71
------TRUCK DRIVERS------		
17a) 2 Axle	28.83	21.39 + a
17b) 3 Axle, 2 Axle Ready Mix	28.93	21.39 + a

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17c) 3 Axle Ready Mix	28.98	21.39 + a
17d) 4 Axle, Heavy Duty Trailer up to 40 tons	29.03	21.39 + a
17e) 4 Axle Ready Mix	29.08	21.39 + a
17f) Heavy Duty Trailer (40 Tons and Over)	29.28	21.39 + a
17g) Specialized Earth Moving Equipment (Other Than Conventional Type on-the-Road Trucks and Semi-Trailers, Including Euclids)	29.08	21.39 + a
18) Sprinkler Fitter (Trade License required: F-1,2,3,4)	41.37	20.77 + a

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19) Theatrical Stage Journeyman	25.76	7.34

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Welders: Rate for craft to which welding is incidental.

**Note: Hazardous waste removal work receives additional $1.25 per hour for truck drivers.*

***Note: Hazardous waste premium $3.00 per hour over classified rate*

ALL Cranes: When crane operator is operating equipment that requires a fully licensed crane operator to operate he receives an extra $3.00 premium in addition to the hourly wage rate and benefit contributions:

1) Crane handling or erecting structural steel or stone; hoisting engineer (2 drums or over)

2) Cranes (100 ton rate capacity and over) Bauer Drill/Caisson

3) Cranes (under 100 ton rated capacity)

Crane with 150 ft. boom (including jib) - $1.50 extra
Crane with 200 ft. boom (including jib) - $2.50 extra
Crane with 250 ft. boom (including jib) - $5.00 extra
Crane with 300 ft. boom (including jib) - $7.00 extra
Crane with 400 ft. boom (including jib) - $10.00 extra

All classifications that indicate a percentage of the fringe benefits must be calculated at the percentage rate times the "base hourly rate".

Apprentices duly registered under the Commissioner of Labor's regulations on "Work Training Standards for Apprenticeship and Training Programs" Section 31-51-d-1 to 12, are allowed to be paid the appropriate percentage of the prevailing journeymen hourly base and the full fringe benefit rate, providing the work site ratio shall not be less than one full-time journeyperson instructing and supervising the work of each apprentice in a specific trade.

The Prevailing wage rates applicable to this project are subject to annual adjustments each July 1st for the duration of the project.

Each contractor shall pay the annual adjusted prevailing wage rate that is in effect each July 1st, as posted by the Department of Labor.

It is the contractor's responsibility to obtain the annual adjusted prevailing wage rate increases directly from the Department of Labor's website.

The annual adjustments will be posted on the Department of Labor's Web page: www.ct.gov/dol. For those without internet access, please contact the division listed below.

The Department of Labor will continue to issue the initial prevailing wage rate schedule to the Contracting Agency for the project.

All subsequent annual adjustments will be posted on our Web Site for contractor access.

Contracting Agencies are under no obligation pursuant to State labor law to pay any increase due to the annual adjustment provision.

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Effective October 1, 2005 - Public Act 05-50: any person performing the work of any mechanic, laborer, or worker shall be paid prevailing wage

All Person who perform work ON SITE must be paid prevailing wage for the appropriate mechanic, laborer, or worker classification.

All certified payrolls must list the hours worked and wages paid to All Persons who perform work ON SITE regardless of their ownership i.e.: (Owners, Corporate Officers, LLC Members, Independent Contractors, et. al)

Reporting and payment of wages is required regardless of any contractual relationship alleged to exist between the contractor and such person.

~~Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clause (29 CFR 5.5 (a) (1) (ii)).

Please direct any questions which you may have pertaining to classification of work and payment of prevailing wages to the Wage and Workplace Standards Division, telephone (860)263-6790.

As of: **Monday, November 07, 2016**

SILVER / PETRUCELLI ASSOCIATES
Architects / Engineers / Interior Designers
3190 Whitney Avenue, Hamden, CT 06518-2340
Tel: 203 230 9007 Fax: 203 230 8247
silverpetrucelli.com

Sign-in Sheet
November 7, 2016

Project: West Shore Middle School Additions and Alterations
(4:00PM)

NAME	COMPANY	PHONE	MOBILE	EMAIL
Joe Vollano	AIG Asbestos	203-530-6763		JVollano@AIGCORP.ORG
Jose Reis	Reis construction masonry	(203) 736-4782		Reisconstructionworks@gmail.com
Jim Ryan	Greenwood Industries	774-248-1059		jryan@greenwood-industries.com
Frank Ettore	Northeast	203 627-7182		Frank@Treeblue Cos.com
Pat Lewis	All Electric	203-5351244		Pat@allelectricct.com

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Sign-in Sheet

November 7, 2016

Project: West Shore Middle School Additions and Alterations
(4:00PM)

NAME	COMPANY	PHONE	MOBILE	EMAIL
DAN Secondino	A. Secondino & Son	203-481-3496		dan@asecondinoandson.com
Stan Stackura Jr	New England Masonry Contractors	203-284-9972	860 982-9177	sstackurajr@neyclle.com
DAVID MACKENZIE	STANDARD DEMOLITION	203 380 8300	203 380 8944	DMACKENZIE@DEMOLITIONSERVICES.COM
Zach Esterman	Vantagetop Scaffolding + Shoring	203 223 7881	"	vantagetop@gmail.com
Steve Butler	ENFIELD BUILDERS	860 627 6870		sbutler@enfieldbuilders.com

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Sign-in Sheet

November 7, 2016

Project: West Shore Middle School Additions and Alterations
(4:00PM)

NAME	COMPANY	PHONE	MOBILE	EMAIL
JOEL MROSEK	SELECTIVE SERVICE	860324-8000	SAME	SELECTIVESERVICELLC@GMAIL.COM
Cody Jacques	Johnson Controls	860-236-[illegible]	—	williams.cody.l.jacques@jci.com
Vincent Parete	LaRosa Building	203-235 1770	same	VParete@Larosabs.com
Rich Jagoe	T.H.P	203-372-3583		richjagoe@thp-gc.com
Rich Mcloughlin	Banton Construction	203 2342353	—	rmcloughlin@bantonconstruction.com

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Sign-in Sheet

November 7, 2016

Project: West Shore Middle School Additions and Alterations
(4:00PM)

NAME	COMPANY	PHONE	MOBILE	EMAIL
DAN PINO	OLYMPUS CONSTRUCTION	203-878-1544	203-258-8365	OLYMPUSJIM@AOL.COM
Tim Tarini	Bismark Const	203 876 8331	203 876 8425	ttarini@bismarkconstruction.com
GORDON SOPER	PDS Engineering & Const	860-242-8581	203-895-1954	GORDON.SOPER@PDSEC.COM
OLLIE D'AMARIO	FUSCO CORP.	203-777-7451		odamario@FUSCO.COM

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Sign-in Sheet
November 7, 2016

Project: West Shore Middle School Additions and Alterations
(4:00PM)

NAME	COMPANY	PHONE	MOBILE	EMAIL
ROEL LEGASPI	NOSAL BUILDERS, INC.	860-347-5674	860-707-9953	ROEL@NOSALBUILDERS.COM
C PETRE	VIKING CONST.	203 3530260	—	CHRISTOPHER.PETRE@VIKINGCONSTRUCTION.NET
D. Jillson	Sarracco Mech / Contractors	203-410-6168		DJillson@Sarracco.com
T. GALLAGHER	CENTER EARTH	2033142924		tgallagher@Centerplan.com
J. Maiuolo	Worth Construction	203 797-8788		maiuolo@worthconstruction.com
MICHAEL JACKSON	THP	203 372-3583		mjackson@thp-gc.com

Richard Abrahams

From: Marie <mmaia@montagno.com>
Sent: Wednesday, November 02, 2016 2:43 PM
To: Richard Abrahams
Cc: Paul Jorgensen
Subject: RE: Specifications/Qualifications for West Shore Middle School

Thank you. This is sufficient information. We are certified in Group C. Marie

Marie Maia
Director of Business Development & Marketing

MONTAGNO CONSTRUCTION
30 Years of RELATIONSHIPS BUILT ON TRUST

2015-16 SUPPORTER NAIS

CAHCF

CONSTRUCTION MANAGERS | GENERAL CONTRACTORS ~ AA | EOE
P: (203) 597-9014 ext. 24
C: (203) 808-2885
F: (203) 573-0517
mmaia@montagno.com
www.montagno.com

From: Richard Abrahams [mailto:rabrahams@silverpetrucelli.com]
Sent: Wednesday, November 02, 2016 2:39 PM
To: mmaia@montagno.com
Cc: Paul Jorgensen <pjorgensen@silverpetrucelli.com>
Subject: RE: Specifications/Qualifications for West Shore Middle School

Good Afternoon Marie,

Division 00 in The Bid Documents includes AIA Document A305 – 1986 "Contractor's Qualification Statement". The specific criteria are listed there. In addition, the Invitation to Bid indicates the minimum classification required is GENERAL CONSTRUCTION B.

Richard Abrahams, RA, NCARB, CSI, CCCA
Specifications Writer/Architect

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Architects / Engineers / Interior Designers

3190 Whitney Avenue Bldg 2 | Hamden, CT 06518 | silverpetrucelli.com | P: 203.230.9007 x 231 | F: 203.230.8247

From: Paul Jorgensen
Sent: Tuesday, November 01, 2016 1:13 PM
To: Richard Abrahams <rabrahams@silverpetrucelli.com>
Subject: FW: Specifications/Qualifications for West Shore Middle School

Put into folder…

Paul Jorgensen, AIA
Associate, Project Architect

SILVER / PETRUCELLI + ASSOCIATES
P: 203.230.9007 x 208 | F: 203.230.8247 | C: 203.435.7447

From: Marie [mailto:mmaia@montagno.com]
Sent: Tuesday, November 01, 2016 1:03 PM
To: Paul Jorgensen <pjorgensen@silverpetrucelli.com>
Subject: Specifications/Qualifications for West Shore Middle School

Dear Paul,
Montagno Construction is bonded to $20,000,000 per job and is DAS Certified Group C; so at face value, we are qualified to submit a bid on the West Shore Middle School Phase 1 Renovation and Alteration. My questions are: do the specifications include a contractor qualification section with specific criteria? If so, what are the criteria?
Thank you, and best regards,

Marie Maia
Director of Business Development & Marketing

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CONSTRUCTION MANAGERS | GENERAL CONTRACTORS ~ AA | EOE
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C: (203) 808-2885
F: (203) 573-0517
mmaia@montagno.com
www.montagno.com

Richard Abrahams

From: Richard Abrahams
Sent: Wednesday, November 02, 2016 11:01 AM
To: 'John Abbate'
Cc: Paul Jorgensen; Fred Bialka
Subject: RE: West Shore Middle School Expansion and Alterations

Correct. Only the GC's need to submit CT DAS certificates and Bid Bonds.

Richard Abrahams, RA, NCARB, CSI, CCCA
Specifications Writer/Architect

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From: John Abbate [mailto:John@fireprotectiontesting.com]
Sent: Wednesday, November 02, 2016 10:26 AM
To: Richard Abrahams <rabrahams@silverpetrucelli.com>
Cc: Paul Jorgensen <pjorgensen@silverpetrucelli.com>; Fred Bialka <fbialka@ci.milford.ct.us>
Subject: RE: West Shore Middle School Expansion and Alterations

Richard,

So there are several GCs bidding that are required to submit bid bonds and CT DAS certificates only, not the subs from what my interpretation is of your response. Thank you for your time.

Sincerely,

John Abbate Jr.
Senior Construction Manager
Fire Protection Testing Company Inc.
Connecticut Fire Protection Unlimited Contractor FRP.0010011-F1
Board of Directors / National Fire Sprinkler Association – Connecticut Chapter **NFSACTCHAPTER.COM**
1701 Highland Ave.
Cheshire, CT,06410
203.250.1115 Office
203.250.1116 Fax
860.578.0382 Cell
An Affirmative Action / Equal Opportunity Employer

FIRE PROTECTION TEAM

From: Paul Jorgensen [mailto:pjorgensen@silverpetrucelli.com]
Sent: Wednesday, November 02, 2016 10:21 AM
To: Fred Bialka <fbialka@ci.milford.ct.us>; John Abbate <John@fireprotectiontesting.com>
Cc: Richard Abrahams <rabrahams@silverpetrucelli.com>
Subject: RE: West Shore Middle School Expansion and Alterations

Fred and John,

This is not a construction management job and only a DAS certificate is required of the general contractor.

We do not require DAS certificates from any of the subcontractors, and only one from each of the bidding general contractors.

Paul

Paul Jorgensen, AIA
Associate, Project Architect

SILVER / PETRUCELLI + ASSOCIATES
P: 203.230.9007 x 208 | F: 203.230.8247 | C: 203.435.7447

From: Fred Bialka [mailto:fbialka@ci.milford.ct.us]
Sent: Wednesday, November 02, 2016 9:41 AM
To: Paul Jorgensen <pjorgensen@silverpetrucelli.com>
Subject: FW: West Shore Middle School Expansion and Alterations

Paul,

Would you provide a response to this question?

Thank you,

Fred

From: John Abbate [mailto:John@fireprotectiontesting.com]
Sent: Wednesday, November 02, 2016 9:11 AM
To: Fred Bialka
Subject: RE: West Shore Middle School Expansion and Alterations

Fred,

Thank you for the information. I saw where the CT DAS certificate is required for bid packages over $500,00.00. I'm assuming that the fire protection budget for this project is under that? Please let me know if it is.

Sincerely,

John Abbate Jr.
Senior Construction Manager
Fire Protection Testing Company Inc.
Connecticut Fire Protection Unlimited Contractor FRP.0010011-F1
Board of Directors / National Fire Sprinkler Association – Connecticut Chapter **NFSACTCHAPTER.COM**
1701 Highland Ave.
Cheshire, CT,06410
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203.250.1116 Fax
860.578.0382 Cell
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FIRE PROTECTION TEAM

From: Fred Bialka [mailto:fbialka@ci.milford.ct.us]
Sent: Wednesday, November 02, 2016 8:48 AM
To: John Abbate <John@fireprotectiontesting.com>
Subject: RE: West Shore Middle School Expansion and Alterations

John,

A **non-mandatory pre-bid meeting** between prospective bidders and the architect will convene in the lobby of West Shore Middle School, 70 Kay Avenue, Milford, CT 06460, at 4**:00 p.m., Monday, November 7, 2016** when project details will be discussed and questions answered. This will be the only pre-bid meeting.

Best Regards,

Fred

From: John Abbate [mailto:John@fireprotectiontesting.com]
Sent: Wednesday, November 02, 2016 8:34 AM
To: Fred Bialka
Subject: West Shore Middle School Expansion and Alterations

Fred,

When is the mandatory pre bid meeting for subcontractors supposed to be?

Sincerely,

John Abbate Jr.

Senior Construction Manager
Fire Protection Testing Company Inc.
Connecticut Fire Protection Unlimited Contractor FRP.0010011-F1
Board of Directors / National Fire Sprinkler Association – Connecticut Chapter **NFSACTCHAPTER.COM**
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203.250.1115 Office
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860.578.0382 Cell
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FIRE PROTECTION TEAM

Richard Abrahams

From: Richard Abrahams
Sent: Monday, November 07, 2016 1:42 PM
To: Paul Jorgensen
Subject: RE: West Show Middle School Phase 1

Yes. And please place it in the RFI's & Responses folder. Thanks.

Richard Abrahams, RA, NCARB, CSI, CCCA
Specifications Writer/Architect

CELEBRATING 25 years 1991 - 2016

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Architects / Engineers / Interior Designers

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From: Paul Jorgensen
Sent: Monday, November 07, 2016 12:23 PM
To: Richard Abrahams <rabrahams@silverpetrucelli.com>
Cc: William Silver <bsilver@silverpetrucelli.com>
Subject: FW: West Show Middle School Phase 1

Can I just reply "everything minus FF+E" ☺

Paul Jorgensen, AIA
Associate, Project Architect

SILVER / PETRUCELLI + ASSOCIATES
P: 203.230.9007 x 208 | F: 203.230.8247 | C: 203.435.7447

From: Kristine Lemmis [mailto:kl@melwoodcontracting.com]
Sent: Monday, November 07, 2016 12:16 PM
To: Paul Jorgensen <pjorgensen@silverpetrucelli.com>
Cc: James Lemmis <jl@melwoodcontracting.com>
Subject: West Show Middle School Phase 1

Hi Paul

Can you tell me what Phase 1 includes for the above reference project?

***** Effective February 29, 2016 we have moved to the address below.**

Kristine Lemmis
Melwood Contracting
303 Linwood Ave

Suite 1A
Fairfield, CT 06824
Phone (203)254-2040
Fax (203)254-2043

kl@melwoodcontracting.com

RFI #1

BH

Builders Hardware

230 Long Hill Cross Road
Shelton, CT 06484
Phone: 203.380-2122 Fax: 203.380-0133

REQUEST FOR INFORMATION

Customer: Bismark Date: 11/10/16

Attention: Ron / Tim From: Michael Moran

Fax/Email: Phone:

Job Name West Shore School CC:

URGENT REPLY REQUESTED

OUR QUOTE OR ORDER IS ON HOLD PENDING RECEIPT OF REQUESTED INFORMATION, THANK YOU.

Line	Question	Answer
1	Are openings 102D, 104A, and 133C actually aluminum frames and doors and not hollow metal as indicated on the door schedule ?	
	yes, 102D, 104A, and 133C Are Aluminum Doors	

RFI #2

BH

Builders Hardware

230 Long Hill Cross Road
Shelton, CT 06484
Phone: 203.380-2122 Fax: 203.380-0133

REQUEST FOR INFORMATION

Customer: Bismark Date:

Attention: Ron / Tim From: Michael Moran

Fax/Email: Phone:

Job Name West Shore School CC:

URGENT REPLY REQUESTED

OUR QUOTE OR ORDER IS ON HOLD PENDING RECEIPT OF REQUESTED INFORMATION, THANK YOU.

Line	Question	Answer
1	Please provide HM frame elevation type H for tag# 172.	172 IS FRAME ELEVATION H.1
2	Please provide HM frame elevation type(s) for tag# 174 and 178.	FRAME TYPE B SEE REVISED DWG. A910
3	Please advise what tag#'s HM frame elevation types E.1, F.1, G.1 and H.1 should be assigned to.	DOORS ARE ALL TAGGED IN PLAN. E.1 IS DOOR 161 H.1 IS DOOR 172, F.1 AND G.1 HAVE NO DOORS AND ARE HM FRAMES WITH GLASS ONLY LOCATED IN MEDIA ON DWG. A103
		REVISED A910 ATTACHED TO ADDENDUM

SECTION 238216 - HYDRONIC AIR COILS

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 hydronic heating and cooling air coils.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each air coil.
2. Include rated capacities, operating characteristics, and pressure drops for each air coil.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which coil location and ceiling-mounted access panels are shown and coordinated with each other.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air coils to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 DESCRIPTION

A. ASHRAE Compliance: Comply with applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

2.2 COILS

A. Manufacturers:
   1. Capital Coil.
   2. USA Coil.
   3. Colmac Coil.
   4. Coil Company.

B. Performance Ratings: Tested and rated according to AHRI 410 and ASHRAE 33.

C. Minimum Working-Pressure/Temperature Ratings: 200 psig, 325 deg F.

D. Source Quality Control: Factory tested to 300 psig.

E. Tubes: ASTM B 743 copper, minimum 0.035 inch thick.

F. Fins: Aluminum minimum 0.006 inch thick.

G. Headers: Seamless copper tube with brazed joints, prime coated.

H. Frames: Galvanized-steel channel frame, minimum 0.052 inch flanged mounting.

I. Hot-Water Coil Capacities and Characteristics: As Scheduled on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine ducts, plenums, and casings to receive air coils for compliance with requirements for installation tolerances and other conditions affecting coil performance.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before coil installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install coils level and plumb.

B. Install coils in metal ducts and casings constructed according to SMACNA's "HVAC Duct Construction Standards, Metal and Flexible."

C. Straighten bent fins on air coils.

D. Clean coils using materials and methods recommended in writing by manufacturers, and clean inside of casings and enclosures to remove dust and debris.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to coils to allow service and maintenance.

C. Connect water piping with unions and shutoff valves to allow coils to be disconnected without draining piping. Control valves are specified in Section 230900 "Instrumentation and Controls for HVAC Systems", and other piping specialties are specified in Section 232116 "Hydronic Piping Specialties."

END OF SECTION 238216

SECTION 238236 - FINNED-TUBE RADIATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings 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. Section includes hydronic finned-tube radiation heaters.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, and details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include details and dimensions of custom-fabricated enclosures.
4. Indicate location and size of each field connection.
5. Indicate location and arrangement of piping valves and specialties.
6. Indicate location and arrangement of integral controls.
7. Include enclosure joints, corner pieces, access doors, and other accessories.
8. Include diagrams for power, signal, and control wiring.

C. Samples: For each exposed product and for each color and texture specified.

D. Color Samples for Initial Selection: For finned-tube radiation heaters with factory-applied color finishes.

E. Color Samples for Verification: For each type of exposed finish.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Structural members, including wall construction, to which finned-tube radiation heaters will be attached.
2. Method of attaching finned-tube radiation heaters to building structure.
3. Penetrations of fire-rated wall and floor assemblies.

B. Field quality-control reports.

PART 2 - PRODUCTS

2.1 HOT-WATER FINNED-TUBE RADIATION

A. Manufacturers:
1. Sterling.
2. Slant-fin.
3. Trane.
4. Vulcan.
5. Rittling

B. Performance Ratings: Refer to Schedule on Drawings.

C. Heating Elements:

1. Tube Diameter: NPS 3/4 and NPS 1.
2. Fin Size: 4.25 inches x 3.625 inches.
3. Fin Spacing: 50 fins per foot.
4. Number of Tiers: 2
5. Heat Output: As scheduled.
6. Entering-Air Temperature: 65 deg F.
7. Average Water Temperature: 130 deg F.
8. Minimum Water Velocity: 1.5 fps.

D. Enclosures: Element Supports: Ball-bearing cradle type to permit longitudinal movement on enclosure brackets.

E. Front Panel: Minimum 16 gauge steel.

F. Wall-Mounted Back Panel: Minimum 0.0329-inch- thick steel, full height, with full-length channel support for front panel without exposed fasteners.

G. Support Brackets: Locate at maximum 36-inch spacing to support front panel and element.

H. Finish: Baked-enamel finish in manufacturer's custom color as selected by Architect.

I. Damper: Knob-operated internal damper at enclosure outlet where scheduled.

J. Access Doors: Factory made, permanently hinged with tamper-resistant fastener, minimum size 6 by 7 inches, integral with enclosure.

K. Enclosure Style: Sloped top.

1. Top Outlet Grille: Punched louver; painted to match enclosure.
2. Enclosure Height: As scheduled.
3. Enclosure Depth: 5-5/16 inches.

L. Accessories: Filler sections, corners, relay sections, and splice plates all matching the enclosure and grille finishes.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive finned-tube radiation heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine areas to receive finned-tube radiation heaters for obstructions to wall to wall enclosures.

C. Examine roughing-in for hydronic-piping connections to verify actual locations before installation of finned-tube radiation heaters.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FINNED-TUBE RADIATION HEATER INSTALLATION

A. Install units level and plumb.

B. Install enclosure continuously around corners, using outside and inside corner fittings.

C. Join sections with splice plates and filler pieces to provide continuous enclosure.

D. Install access doors for access to valves.

E. Install enclosure continuously from wall to wall.

F. Terminate enclosures with manufacturer's end caps except where enclosures are indicated to extend to adjoining walls.

G. Install valves within reach of access door provided in enclosure.

H. Install air-seal gasket between wall and recessed flanges or front cover of fully recessed unit.

I. Install piping within pedestals for freestanding units.

3.3 CONNECTIONS

A. Piping installation requirements are specified in Section 232113 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect hot-water finned-tube radiation heaters and components to piping according to Section 232113 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties."

1. Install shutoff valves on inlet and outlet, and balancing valve on outlet.

C. Connect steam finned-tube radiation heaters and components to piping according to Section 232213 "Steam and Condensate Heating Piping" and Section 232216 Steam and Condensate Piping Specialties."

1. Install shutoff valve on inlet; install strainer, steam trap, and shutoff valve on outlet.

D. Install control valves as required by Section 230923.11 "Control Valves."

E. Install piping adjacent to finned-tube radiation heaters to allow service and maintenance.

F. Ground electric finned-tube radiation heaters according to Section 260526 "Grounding and Bonding for Electrical Systems."

G. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Units will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 238236

SECTION 238239 – HEATING TERMINAL UNITS

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 unit heaters and cabinet unit heaters with hot-water coils.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. DDC: Direct digital control.

C. PTFE: Polytetrafluoroethylene plastic.

D. TFE: Tetrafluoroethylene plastic.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, and details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include location and size of each field connection.
4. Include details of anchorages and attachments to structure and to supported equipment.
5. Include equipment schedules to indicate rated capacities, operating characteristics, furnished specialties, and accessories.
6. Indicate location and arrangement of piping valves and specialties.
7. Indicate location and arrangement of integral controls.
8. Wiring Diagrams: Power, signal, and control wiring.

C. Samples: For each exposed product and for each color and texture specified.

D. Samples for Initial Selection: Finish colors for units with factory-applied color finishes.

E. Samples for Verification: Finish colors for each type of cabinet unit heater indicated with factory-applied color finishes.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Suspended ceiling components.
2. Structural members to which cabinet unit heaters will be attached.
3. Method of attaching hangers to building structure.
4. Size and location of initial access modules for acoustical tile.
5. Items penetrating finished ceiling, including the following:

    a. Lighting fixtures.
    b. Air outlets and inlets.
    c. Speakers.
    d. Sprinklers.
    e. Access panels.

6. Perimeter moldings for exposed or partially exposed cabinets.

B. Seismic Qualification Certificates: Submit certification that cabinet unit heaters, accessories, and components will withstand seismic forces defined in Section 230548 "Vibration and Seismic Controls for HVAC." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Include detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For cabinet unit heaters to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

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. Cabinet Unit-Heater Filters: Furnish two spare filter(s) for each filter installed.

PART 2 - PRODUCTS

2.1 CABINET UNIT HEATERS

A. Manufacturers:
1. Sterling.
2. Slant-fin.
3. Trane.
4. Vulcan.
5. Rittling

B. Description
1. Factory-assembled and -tested unit complying with AHRI 440.
2. 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.
3. Comply with UL 2021.

C. Performance Requirements
1. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
2. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."
3. Seismic Performance: Cabinet unit heaters shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
4. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified.

D. Coil Section Insulation
1. Insulation Materials: ASTM C 1071; surfaces exposed to airstream shall have aluminum-foil facing erosion-resistant coating to prevent erosion of glass fibers.
   a. Thickness: minimum 1/2 inch thick.
   b. Thermal Conductivity (k-Value): 0.26 Btu x in./h x sq. ft. at 75 deg F mean temperature.
   c. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
   d. Adhesive: Comply with ASTM C 916 and with NFPA 90A or NFPA 90B.
   e. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

E. Cabinets
1. Material: Steel with baked-enamel finish with manufacturer's standard paint, in color selected by Architect.
   a. Vertical Unit, Exposed Front Panels: Minimum 0.0677-inch-thick galvanized sheet steel, removable panels with channel-formed edges secured with tamperproof cam fasteners.
   b. Recessed Flanges: Steel, finished to match cabinet.
   c. Control Access Door: Key operated.
   d. Base: Minimum 0.0528-inch- thick steel, finished to match cabinet, 4 inches high with leveling bolts.
   e. Extended Piping Compartment: 8-inch- wide piping end pocket.

f. False Back: Minimum 0.0428-inch-thick steel, finished to match cabinet.

F. Filters
1. Minimum Arrestance: And a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
2. Glass Fiber Treated with Adhesive: 80 percent arrestance and MERV 5.

G. Coils
1. Hot-Water Coil: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch and rated for a minimum working pressure of 200 psig and entering-water temperature of 220 deg F. Include manual air vent and drain.

H. Fam-Motor Assembly
1. Fan and Motor Board: Removable.
a. Fan: Forward curved, double width, centrifugal, directly connected to motor; thermoplastic or painted-steel wheels and aluminum, painted-steel, or galvanized-steel fan scrolls.
b. Motor: Permanently lubricated, multispeed; resiliently mounted on motor board. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."
c. Wiring Terminations: Connect motor to chassis wiring with plug connection.

I. Factory, Hot-Water Piping Package: ASTM B 88, Type L copper tube with wrought-copper fittings and brazed joints. Label piping to indicate service, inlet, and outlet.

1. Two-Piece, Ball Valves: Bronze body with full-port, chrome-plated bronze ball; PTFE or TFE seats; and 600-psig minimum CWP rating and blowout-proof stem.
2. Calibrated-Orifice Balancing Valves: Bronze body, ball type, 125-psig working pressure, 250 deg F maximum operating temperature; with calibrated orifice or venture, connection for portable differential pressure meter with integral seals, threaded ends, and equipped with a memory stop to retain set position.
3. Y-Pattern, Hot-Water Strainers: Cast-iron body (ASTM A 126, Class B); 125-psig minimum working pressure; with threaded connections, bolted cover, perforated stainless-steel basket, and bottom drain connection. Include minimum NPS 1/2 threaded pipe and full-port ball valve in strainer drain connection.
4. Wrought-Copper Unions: ASME B16.22.

J. Control devices and operational sequences are specified in Section 230923 "Direct Digital Control (DDC) System for HVAC" and Section 230993.11 "Sequence of Operations for HVAC DDC."
a. Manual fan-speed switch.

K. Interface with DDC System for HVAC Requirements:

1. Interface relay for scheduled operation.
2. Interface relay to provide indication of fault at central workstation.
3. Interface shall be BAC-net compatible for central DDC system for HVAC workstation and include the following functions:

a. Adjust set points.
b. Cabinet unit-heater start, stop, and operating status.
c. Data inquiry, including supply-air and room-air temperature.

d. Occupied and unoccupied schedules.

L. Electrical Connection: Factory-wired motors and controls for a single field connection.

M. Capacities and Characteristics: Refer to Cabinet Unit Heater Schedule on drawings.

2.2 UNIT HEATERS

A. Manufacturers:
1. Sterling.
2. Trane.
3. Modine.
4. Vulcan.

B. Description
1. Factory-assembled and -tested unit complying with AHRI 440.
2. 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.
3. Comply with UL 2021.

C. Performance Requirements
1. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
2. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."
3. Seismic Performance: Cabinet unit heaters shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
4. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified.

D. Housings
1. Finish: Manufacturer's standard baked enamel applied to factory-assembled and -tested propeller unit heaters before shipping.
2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
3. Discharge Louver: Adjustable fin diffuser for horizontal units and conical diffuser for vertical units.

E. Coils
1. General Coil Requirements: Test and rate hot-water propeller unit-heater coils according to ASHRAE 33.
2. Hot-Water Coil: Copper tube, minimum 0.025-inch wall thickness, with mechanically bonded aluminum fins spaced no closer than 0.1 inch and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 325 deg F, with manual air vent. Test for leaks to 350 psig underwater.
3. Hot-Water Coil: Steel tube, minimum 0.049-inch wall thickness, with mechanically bonded aluminum fins spaced no closer than 0.1 inch and rated for a minimum working pressure of 400 psig and a maximum entering-water temperature of 450 deg F, with manual air vent. Test for leaks to 600 psig underwater.

F. Fan and Motor
   1. Fan: Propeller type with aluminum wheel directly mounted on motor shaft in the fan venturi.
   2. Motor: Permanently lubricated, multispeed. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

G. CONTROLS
   1. Control Devices:
      a. Wall-mounted, variable fan-speed switch.
      b. Wall-mounted thermostat.

H. Capacities and Characteristics: Refer to Unit Heater Schedule on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive cabinet unit heaters and unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in locations for piping and electrical connections to verify actual locations before unit-heater installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Coordinate wall openings for recessed cabinet unit heaters based on approved submittals.

B. Install rough-ins for piping and electrical connections.

C. Install equipment in accordance with manufacturer’s installation instructions.

D. Install wall boxes in finished wall assembly; seal and weatherproof. Joint-sealant materials and applications are specified in Section 079200 "Joint Sealants."

E. Install units to comply with NFPA 90A.

F. Install wall-mounted temperature sensors in electrical outlet boxes. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.

G. Install new filters in each cabinet unit heater within two weeks of Substantial Completion.

3.3 CONNECTIONS

A. Piping installation requirements are specified in Section 232113 "Hydronic Piping," Section 232116 Hydronic Piping Specialties," Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Connect piping to cabinet unit heater's factory hot-water piping package if provided. Install the piping package if shipped loose.

D. Comply with safety requirements in UL 1995.

E. Unless otherwise indicated, install union, gate or ball valve and strainer on supply-water connection and union and calibrated balancing valve on return-water connection of cabinet unit heater. Hydronic specialties are specified in Section 232113 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties."

F. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

G. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

B. Units will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.5 ADJUSTING

A. Adjust initial temperature set points.

B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain cabinet unit heaters.

END OF SECTION 238239.13

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

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. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Equipment supports.

B. Related Sections:

1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Division 23 Section "Expansion Fittings and Loops for HVAC Piping" for pipe guides and anchors.
3. Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" for vibration isolation devices.
4. Division 23 Section Metal Ducts for duct hangers and supports.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Pipe stands.
4. Equipment supports.

C. Delegated-Design Submittal: For trapeze hangers 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. Detail fabrication and assembly of trapeze hangers.
2. Design Calculations: Calculate requirements for designing trapeze hangers.

D. Welding certificates.

1.6 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.

5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Flex-Strut Inc.
   b. Unistrut Corporation; Tyco International, Ltd.
   c. Wesanco, Inc.
   d. GS Metals Corp.

2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
3. Standard: MFMA-4.
4. Channels: Continuous slotted steel channel with inturned lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
7. Metallic Coating: Electroplated zinc.

B. Non-MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Anvil International; a subsidiary of Mueller Water Products Inc.
   b. Empire Industries, Inc.
   c. ERICO International Corporation.

2. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
3. Standard: Comply with MFMA-4.
4. Channels: Continuous slotted steel channel with inturned lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.

6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
7. Coating: Zinc.

2.4 THERMAL-HANGER SHIELD INSERTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Carpenter & Paterson, Inc.
2. Clement Support Services.
3. ERICO International Corporation.
4. National Pipe Hanger Corporation.
5. PHS Industries, Inc.

B. Insulation-Insert Material for Cold Piping: ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa) minimum compressive strength and vapor barrier.

C. Insulation-Insert Material for Hot Piping ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa) minimum compressive strength.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

2.5 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type, **zinc-coated** steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.6 ROOF PIPE SUPPORTS

A. Manufacturer
1. Miro Industries, Inc.
2. Alternate manufacturer offering similar product subject to Engineer’s approval.

B. General Requirements for Pipe Stands:
1. Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
2. Support foot and foot pad shall be of sufficient size to limit load transmitted to roof insulation and membrane below manufacturer’s maximum allowable load.

C. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration. Provide support pad between support and roofing membrane.

D. Low-Type, Single-Pipe Stand: One-piece plastic base unit with plastic roller, for roof installation without membrane penetration. Provide support pad between support and roofing membrane.

E. High-Type, Multiple-Pipe Stand:

1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
2. Bases: One or more; plastic, with support pad.
3. Vertical Members: Two or more protective-coated-steel channels.
4. Horizontal Member: Protective-coated-steel channel.
5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

F. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.7 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

B. Rooftop Condensing Unit Supports:
1. Big Foot Stands by RectorSeal or similar product by alternate manufacturer subject to approval of Engineer.
2. Tubular galvanized steel adjustable support stand with 8 inch nylon footings, leveling adjustment, and adjustable framework to match equipment support points.

2.8 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Install factory supports in accordance with manufacturer’s installation instructions.

B. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

C. Provide curb mounted pipe supports where pipe support curbs are indicated on architectural roof plans.

D. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.

2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

E. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

F. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

G. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

H. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Division 07 Section "Roof Accessories" for curbs.

I. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

J. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

K. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

L. Install lateral bracing with pipe hangers and supports to prevent swaying.

M. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 (DN 65) and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

N. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

O. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

P. Insulated Piping:

1. Attach clamps and spacers to piping.

   a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
   b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
   c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

4. Shield Dimensions for Pipe: Not less than the following:

   a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
   b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.

5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 PIPE HANGERS AND SUPPORT SPACING

A. Support horizontal steel and copper as follows:
   1. ½” to 1 ¼” Pipe Size : 6’-0” maximum hanger spacing.
   2. 1 ½” to 2” Pipe Size : 10’-0” maximum hanger spacing.
   3. 2 ½” to 3” Pipe Size : 10’-0” maximum hanger spacing.
   4. 4” to ” Pipe Size : 10’-0” maximum hanger spacing.

B. Pre-Insulated PEX Piping:
   1. Support in accordance with the manufacturer’s requirements but with spacing not exceeding every 3.5 feet.
   2. Minimum rod diameter shall be 3/8 inch for pripe sizes 2 inch and less, ½ inch for 2 ½-3 inches, 5/8 inch for 4 inch pipe size, and ¾ inch for pipe sizes larger that 4 inches.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and 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. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches (40 mm).

3.6 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils (0.05 mm).

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections**.**

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.7 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports,metal trapeze pipe hangers and metal framing systems and attachments for general service applications.

F. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.

G. Use padded hangers for piping that is subject to scratching.

H. Use thermal-hanger shield inserts for insulated piping and tubing.

I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F (566 deg C),pipes NPS 4 to NPS 24 (DN 100 to DN 600), requiring up to 4 inches (100 mm) of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36 (DN 20 to DN 900), requiring clamp flexibility and up to 4 inches (100 mm) of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 (DN 15 to DN 600) if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4 (DN 15 to DN 100), to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8 (DN 20 to DN 200).
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8 (DN 10 to DN 200).
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3 (DN 10 to DN 80).

12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 (DN 65 to DN 900) if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30 (DN 25 to DN 750), from two rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24 (DN 65 to DN 600), from single rod if horizontal movement caused by expansion and contraction might occur.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 (DN 50 to DN 1050) if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 (DN 50 to DN 600) if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 (DN 50 to DN 750) if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24 (DN 24 to DN 600).
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 (DN 20 to DN 600) if longer ends are required for riser clamps.

K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches (150 mm) for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F (49 to 232 deg C) piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F (49 to 232 deg C) piping installations.

L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb (340 kg).
    b. Medium (MSS Type 32): 1500 lb (680 kg).
    c. Heavy (MSS Type 33): 3000 lb (1360 kg).

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches (32 mm).
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.

4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

    a. Horizontal (MSS Type 54): Mounted horizontally.
    b. Vertical (MSS Type 55): Mounted vertically.
    c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

O. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

P. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

Q. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 230529

SECTION 230900 – INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the contract, including general conditions and Division 1 specification sections, apply to this section.

B. The Contractor, Subcontractors, and /or suppliers providing goods and services referenced in or related to this section will be required to support the Commissioning effort in accordance with the requirements identified in Division 01 Section 019113 "General Commissioning Requirements".

1.2 SYSTEM SUMMARY

A. Furnish all labor, materials, tools, equipment, and services to provide a fully integrated Direct Digital Facility Management System (DDC) for the project as indicated in accordance with the provisions of the contract documents.

B. Provide a Building Automation System (BAS) incorporating LonMark certified LONWORKS devices communicating over a Local Operating Network (LON) or BACnet Testing Laboratories (BTL) certified BACnet devices communicating over a Master-Slave Token Passing (MSTP) network at the field level and Niagara^4 based network managers at the network level. The Niagara^4 based network managers shall bridge the Lonworks and/or BACnet/MSTP field communications network to the owner's Local and/or Wide Area Network, as designated by the owner, and shall communicate seamlessly with the other Niagara^4 based devices on the owner's city-wide BAS network. The BAS shall consist of Direct Digital Control (DDC) controllers, Building Controllers (BC), network management tools, programming tools, web browser based Graphical User Interface, sensors, relays, valves, actuators, and other equipment as may be necessary to provide for a complete and operational control system for the HVAC and other building related systems as described within these specifications.

C. The DDC shall consist of the following:

1. Complete Direct Digital Control System as indicated in accordance with the provisions of the contract documents.
2. Open Systems Design - It is the owners expressed goal to implement an open Building Automaton System that will allow products from different manufacturers and/or suppliers to be integrated into a single unified system in order to provide flexibility for expansion, maintenance, and service of the system.
3. Communications - Provide a peer-to-peer networked, stand-alone, distributed control system with the capability to integrate ANSI/ASHRAE Standard 135-2001 BACnet, LONWORKS technology, MODBUS, OPC, and other open communication protocols in one open, interoperable system. Where existing systems using proprietary protocols exist, a gateway or driver may be incorporated to provide for interoperability.

4. Communications - Provide a peer-to-peer networked, stand-alone, distributed control system with the capability to integrate ANSI/ASHRAE Standard 135-2001 BACnet, LONWORKS technology, MODBUS, OPC, and other open communication protocols in one open, interoperable system. Where existing systems using proprietary protocols exist, a gateway or driver may be incorporated to provide for interoperability.
5. Network Management - Network management tools shall be based upon Niagara Framework technology as developed by the Tridium Corporation. All tools and hardware provided shall comply with the current release of the AX Niagara Framework platform.
6. Integration of existing HVAC equipment into the new DDC System.
7. (1) Color Graphics Operator Workstation (OWS), report/ alarm printer
8. Network Control Panels communicating via an Ethernet network utilizing BACnet I/P protocol.
9. Field Control Panels communicating via a BACnet MS/TP protocol. All field control panels will be fully programmable. Application specific controllers that are not fully programmable or configurable are not acceptable.
10. Field devices including sensors, relays, contactors, transducers, switches, valves, dampers, and related electronic control components.
11. This specification defines the minimum equipment and performance requirements for a Direct Digital Control System.
12. It shall be understood that the drawings and specifications describe the approximate locations of the work. Do not scale the drawings to determine exact positions and clearances. Obtain from Architect, Engineer, or the Owner any dimensions not shown.
13. Details of construction and/or workmanship where not specifically described herein or indicated on the drawings shall be subject to the Engineer's or Owner's approval. It is the intent of these specifications to provide complete systems, left in good working order, ready for operation, including necessary labor and materials, whether or not specifically shown on the drawings or mentioned herein.
14. Before submitting proposals, examine the specifications and all drawings relating to the work and become fully informed as to the extent and character of the work and the relation of the work to that of other Sections. Examine the drawings of other Sections to become familiar with all the problems and details of the building construction and to note conditions, which affect the work.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

A. Where work specified under other Sections of these Specifications connects to equipment or systems which are a part of this Section provide proper connection(s) to such equipment including trade coordination. The following sections may have direct links to the installation of the DDC system:

1. Section 230500 – Common Work Results for HVAC
2. Section 250513 – Common Motor Requirements for HVAC Equipment
3. Section 232113 – Hydronic Piping
4. Section 235216 – Condensing Hot Water Boilers
5. Section 237413 – Packaged Outdoor Central-Station Air Handling Units
6. Section 233423 – HVAC Power Ventilator
7. Section 233113 – Metal Duct

8. Section 230519 – Meters and Gages for HVAC Piping
9. Section 230593 – Testing, Adjusting & Balancing for HVAC
10. Section 230993 – Sequence of Operations for HVAC Controls
11. Division 26 – Electrical Work

1.4 SYSTEM PERFORMANCE

A. Comply with the following performance requirements:

1. Graphic Display: Display graphic with minimum 20 dynamic points with current data within 10 seconds.
2. Graphic Refresh: Update graphic with minimum 20 dynamic points with current data within 8 seconds.
3. Object Command: Reaction time of less than 2 seconds between operator command of a binary object and device reaction.
4. Object Scan: Transmit change of state and change of analog values to control units or workstation within 6 seconds.
5. Alarm Response Time: Annunciate alarm at workstation within 45 seconds. Multiple workstations must received alarms within 5 seconds of each other.
6. Program Execution Frequency: Run capability of applications as often as 5 seconds, but selected consistent with mechanical process under control.
7. Performance: Programmable controllers shall execute DDC PID control loops, and scan and update process values and outputs at least once per second.
8. Reporting Accuracy and Stability of Control: Report values and maintain measured variables within tolerances as follows:

    a. Water Temperature: Plus or minus 1°F (0.5°C).
    b. Water Flow: Plus or minus 5% of full scale.
    c. Water Pressure: Plus or minus 2% of full scale.
    d. Space Temperature: Plus or minus 1°F (0.5°C).
    e. Ducted Air Temperature: Plus or minus 1°F (0.5°C).
    f. Outside Air Temperature: Plus or minus 2°F (1.0°C).
    g. Dew Point Temperature: Plus or minus 3°F (1.5°C).
    h. Temperature Differential: Plus or minus 0.25°F (0.15°C).
    i. Relative Humidity: Plus or minus 5%.
    j. Airflow (Pressurized Spaces): Plus or minus 3% of full scale.
    k. Airflow (Measuring Stations): Plus or minus 5% of full scale.
    l. Airflow (Terminal): Plus or minus 10% of full scale.
    m. Air Pressure (Space): Plus or minus 0.01-inch wg (2.5 Pa).
    n. Air Pressure (Ducts): Plus or minus 0.1-inch wg (25 Pa).
    o. Carbon Dioxide: Plus or minus 50 ppm.

1.5 TECHNICAL PROPOSAL

A. A Technical Proposal shall be presented for review prior to a formal submittal. This proposal will be reviewed by the engineer.

B. It is the intent of this specification to describe the performance requirements of the system. The Technical Proposal shall describe, in detail, all requirements and procedure for complete work.

C. Technical Proposal Content

1. A section-by-section listing of clarifications and exceptions taken to these specifications.

D. Identification by the manufacturer's part number of the individual DDC controllers to be provided.

1. Proposed Riser Diagram.
2. Product information sheets for each model of DDC controller indentified on the DDC Riser Diagram.
3. Specific printed product information detailing the operator workstation hardware and software.
4. Project organization, including resumes of each project team member.
5. Project scheduling including anticipated manpower requirements to meet the Owner's schedule.
6. Locations of the DDC Contractor's branch office that would perform both routine maintenance and emergency repair services. Include resumes of each hardware and software technician who would be involved in performing onsite service.
7. Prior project list of five Facility Management Systems of similar size, scope, and complexity, which have been completed and accepted by the Owner. Include: Project Name, Project Owner, Project Address, Contact Name, Contact Phone Number, and a brief description of the system.

1.6 DEFINITIONS

A. Algorithm: A software procedure for solving a recurrent mathematical or logical problem.

B. Analog: A continuously varying signal or value (temperature, current, velocity, etc.).

C. Binary: A two-state system where an "ON" condition is represented by a high signal level and an "OFF" condition is represented by a low signal level.

D. Control Process: The software required to perform a complete control loop from input signal to interlock logic, process calculation to final output signal control.

E. Control Wiring: Includes conduit, wire, and wiring devices to install a complete Control System including motor control circuits, interlocks, thermostats, PE and EP switches and like devices. Includes all wiring from a DDC cabinet to all sensors and points defined in the Points List summary or specified herein and required to execute the sequence of operation. Includes necessary power wiring to all DDC devices, digital controllers including terminal units and actuators.

F. Deadband: A temperature range over which no heating or cooling energy is supplied, such as 72-78°F, i.e. as opposed to a single point changeover or overlap, or a range from setpoint over which no control action is taken.

G. Direct Digital Control System: The portion of the DDC which provided closed loop control of all HVAC equipment.

H. Distributed Control: A system whereby all control processing is decentralized and independent of a central computer. The control system is built up of stand-alone controllers. A single controller failure shall not impact more than one system.

I. Integration: The ability of control system components from different manufacturers to connect together and provide coordinated control via real-time data exchange through a common communications data exchange protocol. Integration shall extend to the operator's workstation software, which shall support user interaction with all control system components.

J. Intranet: Building data network installed as work of other divisions.

K. Network: A system of distributed control units that are linked together on a communication highway. A network allows sharing of point information between all control units. Additionally, a network provides central monitoring and control of the entire system from any distributed control unit location. First tier networks shall provide "Peer-to-Peer" communications. Second tier networks shall provide either "Peer-to-Peer", Master-Slave or Supervised Token Passing communications.

L. Peripheral: Input/Output equipment used to communicate with the computer and make copies of system outputs, peripherals include CRT, printer, tape deck, diskette, etc.

M. PID Control Loop: A mathematical calculation used to evaluate a control input and determined the control output value required to maintain the input value at setpoint. The PID (Proportional, Integral, Derivative) control loop shall have operator adjustable maximum rate of change, P and D gains and loop response time delay. The loop shall be self-integrating so that no integral constant is required and the loop shall not be subject to "Integral Windup".

N. The term "provide" means "provide complete in place", that is, furnished and installed and ready for operation and use.

1.7 DESCRIPTION OF WORK

A. All controllers, sensors and system components required to be mounted in Air Handling Units and DOAS Units shall be pre-programmed and shipped by the DDC System Contractor/Manufacturer to the unit Manufacturer for factory installation. Coordinate and schedule shipping/delivery with Construction Manager.

B. Provide a DDC system that will reside on the schools existing Intranet and be accessible via the WEB.

C. Interface the existing HVAC Systems nor installed as work of this project into the new DDC System. Provide new control components for existing systems as required to achieve interface. All new and existing systems shall be addressable through the new DDC system.

B. The system will be accessible to at least 200 users simultaneously.

C. Furnish a totally native BACnet-based system, including a Microsoft Windows XP operator's workstation, based on a distributed control system in accordance with this specification for a all mechanical systems, including but not limited to: boiler plant, dedicated outdoor air units, packaged rooftop units, air handling units, energy recovery ventilators, reheat coils, cabinet unit heaters, unit heaters, VRV heat pump systems, hot water finned tube radiation, terminal devices, and exhaust fans. The system shall be complete in all respects, including all labor, control accessories, hardware, software, and peripheral devices necessary to execute the sequence of operations, and provide automatic control for each piece of mechanical equipment.

D. The operator's workstation, all building controllers, programmable controllers, and all input/output devices shall communicate using the protocols and network standards as defined by ANSI/AHSRAE Standard 135-2001, BACnet. In other words, all workstations and controllers, including the unitary controllers, shall be native BACnet devices. No gateways shall be used for communication to controllers installed under this section. No LON devices or proprietary devices will be accepted.

E. System will be fully expandable.

F. Only one workstation will be required to operate or access all data.

G. All controllers will be **fully programmable**. Controllers that are "Application Specific" only or "Configurable" will be rejected.

H. Provide all necessary BACnet-compliant hardware and software to meet the system's functional specifications. Provide Protocol Implementation Conformance Statement (PICS) for Windows-based control software and every controller in system, including unitary controllers. All materials and equipment used shall be standard components, regularly manufactured and not custom designed especially for this project. All components shall have been thoroughly tested and proven in actual use.

I. All materials and equipment used shall be standard components, regularly manufactured and not custom designed especially for this project. All components shall have been thoroughly tested and proven in actual use.

J. The DDC control shall possess a modular architecture, permitting expansion through the addition of more Direct Digital Control Panels.

K. Provide full DDC control of all HVAC equipment, as indicated per the sequence of operations and the input/output summary.

L. Provide new Controls or control interface for existing equipment where indicated.

M. The Controls System shall be designed and implemented entirely for use and operation on the Internet and the Owner's Intranet. All aspects of the Controls Systems Operator Interface shall be provided to operate through an IT industry standard Web Browsers such as Internet Explorer or Netscape or approved equivalent. The Web Browser based Operator Interface provided shall not require the procurement of licensing of any special or proprietary software from the Controls Contractor or its suppliers for the Controls Systems OWS. WEB access provided through embedded building controllers will not be acceptable.

N. This project will be constructed in multiple phases over the course of several years as documented in the Construction Manager's schedule. The BMS contractor shall be responsible for maintaining automatic temperature controls for all areas of the building during construction.

1.8 WIRING

A. Installation of the entire building management system shall be by skilled electricians and mechanics, all of whom are properly licensed, trained, and qualified for this work. All wiring shall be installed in accordance with Division 26 Electrical Specifications.

B. Supervision and checkout of the system shall be accomplished by local branch engineers and technicians directly employed by the BMS Contractor.

C. Power wiring for all control equipment, shall be provided by the DDC control contractor from the nearest power panel for this purpose.

D. Electrical wiring for the DDC control shall be performed by qualified electricians directly employed or subcontracted by the BMS Contractor.

1.9 SUBMITTALS

A. Subsequent to acceptance of technical proposal, the BMS Contractor shall submit, within 60 days after award, installation drawings and control strategies for review.

B. Each submittal shall have a cover sheet with the following information provided: Submittal ID number, date, project name, address, and title, BMS Contractor name, address, and phone number, BMS Contractor project manager, quality control manager, and project engineer names, email addresses and phone numbers.

C. Each submittal shall include the following information:

1. DDC Control riser diagram showing all DDC controllers, operator workstations, network repeaters, and network wiring.
2. One-line schematics and system flow diagrams showing the location of all control devices.
3. Points list for each DDC controller, including: Tag, Point Type, System Name, Object Name, Expanded ID, Display Units, Controller Type, Address, Cable Destination, Module Type, Terminal ID, Panel, Slot Number, Reference Drawing, and Cable Number
4. Vendor's own written description for each sequence of operations, to include the following:

    a. Sequences shall reference input/output and software parameters by name and description.
    b. The sequences of operations provided in the submittal by the DDC Contractor shall represent the detailed analysis needed to create actual programming code from the design documents.
    c. Points shall be referenced by name, including all software points such as programmable setpoints, range limits, time delays, and so forth.

d. The sequence of operations shall cover normal operation and operation under the various alarm conditions applicable to that system.

5. User interface functional outline. The outline shall include each display screen to be provided data to be displayed, and links to other screens. The outline level hierarchy shall be:

   a. Site
   b. Building
   c. Floor
   d. System

6. Detailed Bill of Material list for each panel, identifying quantity, part number, description, and associated options.
7. Control Damper Schedules. This spreadsheet type schedule shall include a separate line for each damper and a column for each of the damper attributes, including Code Number, Fail Position, Damper Type, Damper Operator, Blade Type, Bearing Type, Seals, Duct Size, Damper Size, Mounting, and Actuator Type.
8. Control Valve Schedules. This spreadsheet type schedule shall include a separate line for each valve and a column for each of the valve attributes, including, Code Number, Configuration, Close Off Pressure, Capacity, Valve CV, Calc CV, Design Pressure, Actual Pressure, and Actuator Type.
9. Schematic of each air handling system, hydronic system, etc., locating each control component on its respective unit with proper termination point identifiers (include legend). One schematic shall be included for each individual air handling system.
10. Each schematic shall show a chart detailing all hardware components used. The chart shall include:

    a. Schematic Control Symbol
    b. Quantity
    c. Manufacturer's Part Number
    d. Technical Sheet Reference
    e. Description of Part

11. Each Direct Digital Control Panel (DDCP) shall be detailed in the submittal to identify termination boards within each panel and termination of their respective field points. Each termination point shall define the point name and point description by each terminal within the field panel. Point names and descriptors shall be consistent throughout the submittal on schematics, wiring diagrams, equipment lists, etc.
12. The Control manufacturer's technical reference sheets for each hardware component and application program shall be included in the submittal.

    a. Catalogued cut sheets of all equipment used. This includes, but is not limited to, the following: DDC panels, peripherals, sensors, actuators, dampers, control air system, components, and so forth.
    b. Range and scale information for all transmitters and sensors. This sheet shall clearly indicate one device and any applicable options. Where

more than one device to be used is on a single sheet, submit two sheets, individually marked.

c. Training course outlines for each four-hour session.

d. Hardware data sheets for all operator workstations, local access panels, and portable operator terminals.

e. Software manuals for all applications programs to be provided as a part of the operator workstations, portable operator terminals, programming devices, and so forth for evaluation for compliance with the performance requirements of this specification.

f. Initial project team Quality Assurance compliance report.

13. BMS Contractor shall not order material or begin fabrication or field installation until receiving authorization to proceed in the form of an approved submittal. BMS Contractor shall be solely responsible for the removal and replacement of any item not approved by submittal at no cost to the Owner.

14. BMS Contractor shall submit phasing plan that is consistent with schedule of Construction Manager.

1.10 O&M MANUALS

A. Five (5) copies of the Operation and Maintenance Manuals shall be provided to the Owner's representative upon completion of the project. The entire Operation and Maintenance Manual shall be provided on recordable CD media, and include the following:

1. Include the following documentation in the Hardware Manual:

a. General description and cut sheets for all components.

b. Detailed wiring and installation illustrations and complete calibration procedures for each field and panel device.

c. Complete troubleshooting procedures and guidelines.

d. Complete operating instructions for all systems.

e. Maintenance Instructions: Document all maintenance and repair/replacement procedures.

2. Include the following documentation in the DDC Software Manual:

a. Sequence of Operations.

b. Program Listing of Software Source Code or Flow Chart Diagrams of Programming Objects.

c. Printed listing of controller and operator workstation database files.

d. Software Point Name Abbreviation List; include Name, Description, Controller where located, Point Type, and Point ID.

e. I/O Point List. Include Point Name, Controller Location, Point Number, Control Device, Range and Span.

f. Printouts of all reports, group listings, and alarm messages.

g. Index of all DDC point names with documentation, manual page number references.

3. Provide three copies of all manufacturers manuals covering the installed system. This shall include, as a minimum:

   a. System Engineering Manual
   b. System Installation Manual
   c. Programming Manual
   d. Engineering and Troubleshooting Bulletins
   e. Operator Workstation Software Manual
   f. All other pertinent manuals published by the control system manufacturer.

4. Record Drawings

   a. Computer Aided Drawings (CAD) record drawings shall represent the as-built condition of the system and incorporate all information supplied with the approved submittal. All project drawings shall be supplied in .DXF file format.

B. The Operation and Maintenance Manual CD shall be self-contained, and include all necessary software required to access the project record drawings and product data sheets. All software shall be Windows XP compatible. A logically organized table of contents shall provide dynamic links to view and print all project record drawings and product data sheets. Viewer software shall provide the ability to display, zoon, and search all documents. The CD-ROM shall contain adequate space for future system updates.

1.11 SYSTEM TURNOVER AND SERVICE

A. Upon completion of the installation, the DDC Control Contractor shall start up the system and perform all necessary testing and run diagnostics to ensure proper operation. An acceptance test in the presence of the owner representative shall be performed. The acceptance test shall consist of a point-to-point checkout within each DDCP to ensure proper operation of all system components.

B. When the system performance is deemed satisfactory in whole or in part by these observers, the system parts will be accepted for beneficial use and placed under warranty.

C. Problems that occur within approved hardware or software shall be corrected in an appropriate fashion under warranty. Any such occurrence shall not void previous approval; however, the DDC control contractor shall be responsible to attend to, and remedy, such items within the warranty period. Appropriate logs, schedules, and reports shall be maintained to reflect these items and their redress.

1.12 TRAINING OWNER’S INSTRUCTION

A. The DDC contractor shall provide four (4) copies of an operator’s manual describing all operating and routine maintenance service procedures to be used with the system. The DDC control contractor shall instruct the Owner’s designated representatives in these procedures during the start-up and test period. The duration of the instruction period shall be no less than forty (16) hours. These instructions are to be conducted during

normal working hours. The instructions shall consist of both hand-on and classroom training at the job site.

1.13 WARRANTY

A. The Building Management System, including all hardware and software components, shall be warranteed for a period of **two years** following the date of acceptance. Any manufacturing defects arising during this period shall be corrected without cost to the Owner.

B. The BMS contractor shall submit directly to the owner during the warrantee period a proposal covering a Maintenance Agreement to include the newly installed components provided under this scope of work.

1.14 QUALITY ASSURANCE

A. Provide written approvals and certifications after installation has been completed.

B. Manufacturer must prove that he has been engaged in the production, installation and service of this type of equipment for at least ten (10) years and has a fully equipped, factory trained and authorized service organization.

C. The system control contractor shall have been an authorized installing contractor for the manufacturer of the native BACnet components for a minimum of five (5) years, and contractor's office shall be within 45 miles of project site. Installation of controls that are <u>not</u> native BACnet components does not constitute acceptable experience.

D. Final determination of compliance with these specifications shall rest solely with the Owner and Engineer who will require proof of prior satisfactory performance.

E. For any equipment submitted for approval, the BMCS contractor shall state what, if any, specific points of system operation differ from these specifications.

F. The DDC control contractor shall continue to bear the liability for replacement of substituted equipment in the even that the equipment fails to perform as specified, or to meet approval of all authorities having jurisdiction, within twelve (12) months after beneficial use by the owner.

1.15 WORK BY OTHERS

A. The Division 26 electrical contractor shall:

1. Supply, mount, and provide power wiring to all fire alarm devices and smoke detectors.
2. Install and provide power wiring to the motor controller and Variable Frequency Drives provided by the mechanical contractor.
3. Install and provide power wiring to each Terminal Equipment Controller (TEC) provided by the BMS contractor. The BMS contractor shall coordinate with work by other division.

B. The Division 23 mechanical contractor shall:

1. Install control valves and separable wells furnished by the BMS contractor.
2. Install all necessary piping connections required for flow devices.

3. Provide necessary blank-off plates (safing) required to install dampers that are smaller than duct size.
4. Assemble multiple section dampers with required interconnecting linkages and extend required number of shafts through duct for external mounting of damper motors.
5. Provide sheet metal baffle plates for air handling unit mixing boxes when required by BMS contractor to eliminate stratification and provide air volumes specified. Locate baffles by experimentation and affix and seal permanently in place only after stratification problem has been eliminated.
6. Provide access doors or other means of access through ducts for servicing control equipment.
7. Install all automatic dampers provided by the BMS contractor.
8. Provide a minimum of three (3) duct diameters (minimum 36”) of straight duct upstream from every air terminal unit inlet.
9. Provide for dry storage of terminal units and mounted TEC's upon receipt at job site.
10. Notify the BMS contractor that the terminal units are ready for inspection. Every terminal unit shall be installed after the BMS contractor has approved the TEC installation.
11. Insure all TEC's are located a minimum of three (3) feet from all obstructions (walls, pipes, etc.) to remain accessible.
12. Install all airflow measuring devices in ductwork provided by the BMS contractor.

C. The Manufacturer of the Air Handling Units and DOAS Units shall factory install all controllers, sensors and system components furnished by DDC Contractor/Manufacturer and required to be installed the units.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Acceptable manufacturers:

1. Alerton Controls – Ascent with Niagara
2. Distech Controls EC- Net[4]
3. Johnson Controls Facilities Explorer with Niagara
4. Honeywell WEBs with Niagara
4. Other manufacturer’s offering Niagara based controls with HTML5 graphics which are fully compatible with the City wide system, meeting the requirements described in this Section, subject to the approval of the Owner and Engineer.

B. Note: All portions of the specification must be met. If a listed manufacturer cannot or does not meet the specification in any way, the bid will be rejected. It shall be understood that, where catalog numbers of control equipment are mentioned, this will

clearly identify the item in question together with its inherent characteristics, dimensions, functions and capacities.

2.2 NETWORK ARCHITECTURES AND DEVICES

A. Networks – All Niagara[4] based network managers supplied under this section shall bridge the Lonworks, BACnet or ModBus field bus to the owner's Local Area Network (LAN) and/or Wide Area Network (WAN) as designated by the owner. The network managers shall communicate at no less than 100 Megabits/sec over the Ethernet network and shall support BACnet over IP, Java, XML, HTTP, Fox and SOAP for maximum flexibility as it relates to the integration of building data with enterprise information systems. The system shall provide support for multiple network managers, Building Controllers (BC), user workstations and, if specified, a local server. The WAN and/or LAN will be provided by others. The SI shall coordinate with the General Contractor for the access to the WAN and/or LAN. All Niagara network managers on this project must be JACE8000 (Titan) model. User interface MUST be based on HTML5 graphics and trending. JAVA based user interface is NOT acceptable.

1. Network minimum physical and media access requirements:

   a. Ethernet; IEEE standard 802.3
   b. Cable; 100 Base-T, UTP-8 wire, category 5 Minimum throughput; 100 Mbps

2. Network Access - Remote Access - For Local Area Network installations; provide access to the WAN and/or LAN from a remote location, via the Internet. The Owner shall provide a connection to the Internet to enable access via high speed cable modem, asynchronous digital subscriber line (ADSL) modem, ISDN line, T1 Line or via the customer's Intranet to a corporate server providing access to an Internet Service Provider (ISP). The Owner agrees to pay monthly access charges for connection and ISP.

B. Network - Field Level Controllers – The communication network between the field level controllers shall be Lonworks TP/FT 10 bus topology, BACnet MSTP, BACnet/IP, Modbus RS-485 or Modbus/IP. All wiring shall be provided in accordance with the standards for the appropriate protocol. The number of devices on any one network shall not exceed 90% of capacity. All Field level controllers serving AHU, RTU and HW/CHW System must have interactive LCD Display allowing user access to all points locally at the controller (see section 5.2 below).

C. Network Management Devices – These various devices will service multiple functions on the network depending on network design, communication medium and needed task. These functions can include: management of traffic on the network, reconfiguring and strengthening of signals, the conversion of protocols, normalizing of data, global management of alarms, trends and schedules, control logic, protocol conversion and web page hosting for use as a Graphical User Interface.

1. Building Controller (BC) – This Niagara Framework based device shall provide the interface between the LAN or WAN and the field control devices, and provide global supervisory control functions over the control devices connected to the BC.

It shall be provided with these features:

a. Web page hosting

b. Extended memory

c. Network management tools resident within the BC (optional)

d. Appropriate hardware and driver(s) associated with the protocol it manages

e. Din rail mounted power supply

2. LON to LON and Bacnet Routers and Repeaters – A router or repeater may be used on a LON segment between controllers and a BC as a means to manage traffic and reconfigure and strengthen a transmission signal. Routers shall be fully programmable and permit a systems integrator to define message traffic, destination, and other network management functions utilizing LONWORKS. A repeater or signal booster may only be used to increase ths signal strength of the communictions. Under no circumstances may it be used in the place of a router.

3. Server Functions and Hardware – Provide a Personal Computer server along with the Niagara Framework Network management tools and server software, unlimited connectivity version. The server shall support all BCs connected to the customer's network whether local or remote. It shall be possible to provide access to all BC via a single connection to the server. In this configuration, each BC can be accessed from a remote Graphical User Interface (GUI) or from a standard Web Browser Interface (WBI) by connecting to the server. The server shall provide the following functions, at a minimum:

a. Global Data Access: The server shall provide complete access to distributed data defined anywhere in the system.

b. Distributed Control: The server shall provide the ability to execute global control strategies based on control and data objects in any BC in the network, local or remote.

c. The server shall include a master clock service for its subsystems and provide time synchronization for all BCs.

d. The server shall provide scheduling for all Network Area Controllers and their underlying field control devices.

e. The server shall provide demand limiting that operates across all BCs. The server must be capable of multiple demand programs for sites with multiple meters and or multiple sources of energy. Each demand program shall be capable of supporting separate demand shed lists for effective demand control.

f. Provide for browser based graphical home screen with links to each connected BC. See graphic section for additional details.

g. The server shall provide central alarm management for all BC supported by the server. Alarm management shall include:

1. Routing of alarms to display, printer, email and pagers
2. View and acknowledge alarms
3. Query alarm logs based on user-defined parameters

h. The server shall provide central management of log data for all BCs supported by the server. Log data shall include process logs, runtime and

event counter logs, audit logs and error logs. Log data management shall include:

Viewing and printing log data
Exporting log data to other software applications
Query log data based on user-defined parameters

D. "Information sharing" shall be defined as: the function of each DDCP to exchange data on the network trunk with other DDCP's without the need for additional devices such as network managers, gateways or central computers.

D. "Stand-alone" shall be defined as: the function of each DDCP to independently monitor and control connected equipment through its own microcomputer.

E. The DDC Control System shall be based on Niagara 4 and all Controllers and control devices shall have HTML5 capability and support HTML5 interface.

D. All control devices will be electronic.

C. Server Hardware Requirements: The server hardware platform shall have the following requirements: NOTE: Update to Owner standards or latest industry standard performance levels for a PC server

1. The Server shall be a PC with minimum Intel Core i5 Quad core 3.4 GHz processor with 8 GB RAM and a 1TB SATA hard drive with 6 GB/s transfer rate. It shall include a minimum 32X CD-ROM drive and 4-USB ports. A minimum 21", HDMI, DVI-D video interfaces, minimum 1024 x 768 resolution, 4x3 Widescreen, LED color monitor with a minimum 60 Hz refresh rate shall also be included.
2. The server operating system shall be provided with lastest Microsoft Windows Operating Systems server based software that corrisponds to the currently support version of the Niagara Framework and browsers as well asthe latest version of Symantec Antivirus Software including a 1 year upgrade subscription service to the Symantec software.
3. Connection to the BAS LAN network shall be via an Ethernet network interface card, 100 Mbps.
4. A system printer shall be provided. Printer shall be laser type with a minimum 600 x 600-dpi resolution and rated for 60-PPM print speed minimum.

D. Uninterruptable Power Supplies

2. Provide the OWS, Server, and each NCU with individual UPS to provide clean, reliable, noise-filtered power at all times and to protect and maintain systems operation throughout short term power interruptions of up to 15 minutes duration.

2.2 BUILDING AUTOMATION SYSTEM CONTROLLERS

A. All controllers shall be designed for easy installation and servicing including removable enclosures, removable terminals, and factory applied labels for all I/O. All internal points within the Programmable Controllers shall be fully supported by the Graphical User Interface (GUI), allowing the user to easily modify them and monitor them. All of the internal programming points (e.g. variables, constants, PID's, timers, inputs and outputs) shall be exposed to the network on dedicated network variable outputs. All controllers programs and schedules shall contain non-volatile flash memory. Upon a loss of power all controllers shall perform a self restart.

B. Programmable Controllers (PC) – a controller designed for more complex sequences of operations such as built up AHU, central plant operations, electrical monitoring, and control and management for chillers, boilers and generators. The PCs are to allow for the flexibility of custom control programming to meet the needed sequences of operation.

1. Performance – Each PC shall have a minimum of 64K of Non-volatile Flash memory for control applications and 128K non-volatile flash memory for storage with a minimum 32 bit processor. The PC shall have a minimum ambient operating temperature range of -0°C to 70°C or 32°F to 158°F.
2. Inputs – Analog inputs shall have the following minimum level of performance: 16-bit A to D resolution; allow monitoring of platinum 100 ohms, platinum 1000 ohm, nickel 1000 ohms, thermistor 10K type II, thermistor 10K type III, voltage input 0-10VDC, current input 4-20mA, digital input, pulsed input minimum 2 Hz.
3. Outputs – Outputs shall be either software configurable to be either analog or digital or dedicated digital only - Analog outputs shall be selectable as voltage of 0-10 VDC (linear) or 4-20mA or Digital outputs shall be 0-12 VDC (off/on), floating or PWM. Outputs shall have an adjustable range of 2 seconds to 15 minutes. Output Resolution shall be a minimum 10 bit digital / analog converter. All individual outputs and power supply shall be protected by an auto reset fuse. There shall be an LED status indicator on each of the outputs.

C. Programmable Controller Features

1. Provide an onboard network communication jack
2. The PC shall be provided with two on-board RJ45 Connections. One of the RJ45 connections shall serve as a single point connection for connecting a wireless receiver that will enable the PC to accept up to 12 wireless inputs utilizing the EnOcean communcations protocol. The wireless receiver shall have an integrated antenna. The supplier/provider shall provide documentation verifying the strength and reliability of the wireless signal with the submittal package. The second RJ 45 connection shall serve as a single point connection for an integrated room sensor (IRS) with an LCD display. The sensor shall have a fully customizable LCD display. It shall measure occupancy, relative humidity, carbon dioxide and temperature in a single integrated device. Using separate devices for the sensing of occupancy, relative humidity, carbon dioxide and/or temperature is not acceptable. Up to 4 integrated room sensors shall reside on a single daisy-chained communication bus.
3. The LCU shall come standard with a color operator interface that provides real-time access to monitored inputs, setpoints, modes, values, statuses, and outputs.
   A. The operator interface shall consist of :
   B. An icon-based, interactive backlit color display.

C. A turn and select navigation jog dial to access, edit, and modify internal controller functions. The jog dial shall be used to navigate through menus, select options and icons, and change parameters. Scroll buttons (up, down, left and right) shall not be acceptable.

D. Navigable menus to display, select, edit, and modify values and other controller information.

E. List-based menus with a minimum of eight (8) lines of text.

F. Icon-based menus.

G. A display with the following minimum characteristics: a resolution of 400 W x 240 H pixels (WQVGA) with an effective viewing area of 2.4" L x 1.4" H (61.2mm x 36.7 mm), and 2.8" (71mm) diagonal viewing area.

H. The operator interface shall use color-codes with icons and text lists to indicate values and controller statuses.

I. The operator interface shall, at a minimum, have the following functions:

J. Points. The operator interface shall provide points list menus to view the inputs, setpoints, and output values such as hardware inputs/outputs, analog values, binary values, multistate values, Intelligent Space Sensor (ISS) inputs, and wireless inputs.

K. The points list menus shall allow the operator to monitor, set, and override controller points and values.

L. A color-code shall be used to indicate the conditions and statuses of points displayed in the points list menus.

M. Alarms. The operator interface shall provide a controller's alarms menu to view details of an alarm, to acknowledge the alarm, and to view the alarm history.

N. The alarm menu shall allow the operator to view the following type of alarms: active not acknowledged, active acknowledged, and inactive not acknowledged.

O. The combination of an icon and its color state shall notify the operator of an alarm condition.

P. The operator shall be able to select a single point in alarm to view further details such as the alarm to/from status, current status, event date and time, alarm event threshold, and alarm event value.

Q. Overrides. The operator interface shall provide an overrides menu to view a list of the controller's overridden points such as hardware input, hardware output, value, constant, or variable. The menu shall allow the operator to select an overridden point and to modify or release the override on the selected point.

R. PID loops. The operator interface shall provide a PID Loops menu to view, configure, and adjust the PID parameters. The interface shall also provide visual PID tuning with live system response graphing (live-trend).

S. The operator interface shall support Latin-based languages and allow the interface user to select from three (3) defined languages.

T. The operator interface shall allow personalization of a contact information screen with a minimum of eight (8) lines of user configurable text as well as the option to add a color graphic such as a company logo. The tool shall support, but not be limited to, image file formats such as GIF, PNG, JPG, etc.

U. Favorites. The operator interface shall allow access to a list of bookmarked points.

V. Weather. The operator interface shall provide a weather menu to view the current weather conditions with a weather status icon. The units shall be configured to be displayed in either metric or US units.

W. Password protected. The controller operator interface shall provide multi-level password protection, with user-defined, alphanumeric, name/password combinations. The operator interface shall return to lock mode after a user-defined log-off delay. A password icon shall indicate the lock mode state.

X. Settings. The operator interface shall provide a settings menu to view and configure date and time parameters such as the current time, time zone, and daylight savings time.

4. Enclosures – Provide for a plastic enclosure with a separate back plate with terminals such that the electronic portion of the controller can be easily removed for ease of installation and servicing.

A. Operator Workstation

1. The DDC Contractor shall provide and install a personal computer workstation for command entry, information management, network alarm management, and database management functions. All real-time control functions, including scheduling, history collection and alarming, shall be resident in the DDC controllers to facilitate greater fault tolerance and reliability.

a. PC Hardware – The personal computers shall be configured with the minimum requirements as follows:

1) Pentium i3 Microprocessor
2) 1024 MB RAM Memory
3) 250 GB Fixed Drive
4) 48X CD-ROM Drive
5) 101 Enhanced Keyboard
6) Microsoft® Compatible Serial Mouse
7) 20” Flat Panel
8) Microsoft® Windows XP or current level
9) 3Com® TCP/IP 10BaseT Adapter
10) (4) USB Ports

3. Operating System Software: Windows XP or current level.

a. Complete operator workstation software package, including any hardware or software keys. Include the original installation disks and licenses for all included software, device drivers, and peripherals.

b. Provide software registration cards to the Owner for all included software.

4. Peripheral Hardware

a. Printers: Color inkjet by Hewlett Packard or equal.

B. Workstation Application Components

1. Operator Interface

a. An integrated software package shall be used as the operator interface program.
b. All Inputs, Outputs, Setpoints, and all other parameters as defined within Part 3, shown on the design drawings, or required as part of the system software, shall be displayed for operator viewing and modification from the operator interface software.
c. The operator workstation software shall provide context-sensitive help menus and instructions for each operation and/or application currently being performed.
d. All controller software operating parameters shall be displayed for the operator to view/modify from the operator workstation. These include: setpoints, alarm limits, time delays, PID tuning constants, run-times, point statistics, schedules, and so forth.
e. The operation of the control system shall be independent of the operator workstation, which shall be used for operator communications only. Systems that rely on the operator workstation to provide supervisory control over controller execution of the sequences of operations or system communications shall not be acceptable.

2. Alarms

a. Each workstation shall receive and process alarms sent to it by the control system. The alarm management portion of the operator workstation software shall, at the minimum, provide the following functions:

1) Log date and time of alarm occurrence.
2) Generate a “Pop-Up” window informing an operator that an alarm has been received.
3) Allow an operator, with the appropriate security level, to acknowledge, delete, or disable an alarm.
4) Provide an audit trail for alarms by recording operator acknowledgment, deletion, or disabling of an alarm. The audit trail shall include the name of the operator, the alarm, the action taken on the alarm, and a time/date stamp.
5) Record all alarms received at an operator’s workstation to that workstation’s hard drive.
6) Allow the operators to view/manage the alarm data archived to hard disk. Selection of a single menu item or tool bar button shall allow the user to acknowledge, disable, delete, or print the selected alarm.
7) Alarms shall be generated by the operator workstation for any controller that is “off-line” and is not communicating, or that does not have an active control program loaded.

8) Changes made to alarm setpoints from the Operator Workstation shall directly modify the controller alarm management database.

3. Reports

a. Reports shall be generated and directed to one of the following: workstation displays, printers, or disk.

1) As a minimum, the system shall provide the following reports:

a) All points in the network.
b) All points in a specific controller.
c) All points currently in alarm.
d) All points in hardware override.
e) All weekly schedules.

b. All or selected point attributes, including, but not limited to:

1) Values
2) Setpoints
3) Alarm Limits
4) Run Times

c. All programmed holidays and associated schedules.
d. All active, unacknowledged alarms.
e. All active, acknowledged alarms.
f. Any and all other controller operating parameters.
g. The system shall allow for the creation of custom report point groups that shall be capable of including points from multiple controllers. Systems limiting point report displays to only a single controller's point database shall not be accepted.
h. The number of custom reports or display groups shall be limited by the amount of available system memory.
i. Selection of a single menu item, tool bar item, or tool bar button shall print any displayed report on the system printer for use as a building management and diagnostics tool.

4. Schedules

a. Equipment Scheduling:

1) Scheduling of up to 48 discrete schedules with definable calendar dates and the capability of shifting to alternate calendar periods automatically.
2) Scheduling shall be activated by time of day/day of week, input or output state, or other scheduled states, and/or events.
3) Scheduling for time of day/day of week schedules shall have multiple on/off time pairs, include 7 days per week, and temporary schedule for Today/Tomorrow time pairs which will automatically revert to original schedule upon expiration.

4) Scheduling shall allow for definable timed override periods of up to 4 consecutive hours.

b. Holiday Scheduling:

1) Scheduling shall allow for up to 16 definable holiday periods.
2) Holidays shall be programmable for up to 99 consecutive days and allow for automatic repetition of holidays that occur on the same calendar date from year to year.

c. Start Optimization:

1) OS shall be capable of learning building thermal characteristics and respond to variable conditions.
2) OS shall start controlled equipment as late as possible prior to occupied time and as early as possible prior to unoccupied time.
3) OS shall be calculated based on outdoor temperature, zone temperature, and control setpoint/setback parameters. OS calculations shall be updated daily and shall support calculations for 48 discrete time of day/day of week schedules.

d. Setpoint/Setback Optimization:

1) Setpoint/setback control shall modify zone temperature setpoints during unoccupied hours, reducing the heating/cooling load.
2) Timed override for each setpoint control shall permit unoccupied hours adjustments without operator involvement.

5. Password

a. Multiple-level password access protection shall be provided to allow the user/manager to limit workstation control, display, and database manipulation capabilities as he or she deems appropriate for each user, based on an assigned password.
b. Each user shall have the following: a password (4 characters minimum), and an access level (from 1 - 3).
c. The system shall have an administrator level that can allow each user to change his or her password at will.
d. When entering or editing passwords, the system shall not echo the actual characters for display on the monitor.
e. Three levels of access shall be supported as follows:

1) Level 1: monitoring access functions with no parameter access change.
2) Level 2: level 1 access with the addition of access to setpoint parameters, temporary time of day schedules, and data log points.
3) Level 3: complete system database access for an advanced user.

f. A minimum of 10 unique passwords, including user initials, shall be supported.

g. Operators shall be able to perform only those commands available for their respective passwords. Display of menu selections shall be limited to only those items defined for the access level of the password used to log-on.

2.4 OPERATOR INTERFACE

A. General structure of workstation interaction shall be a standard client/server relationship. Server shall be used to archive data and store system database. Clients shall access server for all archived data. Each client shall include flexibility to access graphics from server or local drive. Server shall support a minimum of 200 clients simultaneously.

B. The Operator Workstation shall comply with Annex J of the BACnet specification for IP connections. This device shall use Ethernet to connect to the IP internetwork, while using the same Ethernet LAN for non-IP communications to other BACnet devices on the LAN. Must support interoperability on wide area networks (WANs) and campus area networks (CAN's). Workstation shall support Foreign Device Registration to allow temporary workstation connection to IP network.

C. The Web Browser based Operator Interface shall not require the procurement or licensing of any special or proprietary software from the Controls Contractor or its suppliers for the Control System OWS.

D. Operators will access the system through a dedicated WEB server.

E. Workstation software will become the sole property of the customer. At no time will the customer be required to pay for software or software related "renewal" fees.

F. Alarm Management

1. Prioritization

a. The installer shall set up all system analog points with high and low alarm limits. All digital system points shall be associated with a status feedback point and all exceptions shall be reported as alarms. The user shall be able to define the specific system reaction for each point. Alarms shall be prioritized and filtered to minimize nuisance reporting and to speed operator response to critical alarms.

2. Critical and Non-Critical Alarm Routing

a. Critical alarms shall be defined as chiller, boiler, generator, critical space temperature or humidity. Critical alarms shall be displayed at the workstation, printed at the alarm printer, and alpha paged to the on-duty maintenance person over the owners alphanumeric paging system. Alpha pages shall provide sufficient information to identify the equipment and the point in alarm and the time and date of occurrence.

b. All other alarms shall be considered non-critical and shall be displayed and acknowledged before being sent to the alarm log.

3. Auto-Dial Alarm Management

a. In Dial-up applications, only critical alarms shall initiate a call to a remote operator device. In all other cases, call activity shall be minimized by time-stamping and saving reports until an operator scheduled time, a manual request is made, or until the buffer space is full. The alarm buffer must store a minimum of 50 alarms.

2.5 CENTRAL CONSOLE SOFTWARE

A. Provide an Internet Explorer graphical user interface through which system operation may be performed using a mouse or similar pointing device. Proprietary software will not be acceptable. The interface shall allow for all system operations and applications to be quickly and easily selected using the mouse in conjunction with groups of drop-down menus, lists, graphics and icons. Provide functionality such that all operations can also be performed using the keyboard as a backup interface device. Provide additional capability that allows at least ten (10) special function keys to perform often-used operations.

B. The software shall provide a multi-tasking environment that allows the user to run several applications simultaneously. The mouse shall be used to quickly select and switch between multiple applications. This shall be accomplished using Microsoft Windows or similar industry standard software that supports concurrent viewing and controlling of systems operations. Provide functionality such that any of the following may be performed simultaneously, and in any combination, via user-sized windows.

1. Dynamic color graphics and graphic control
2. Alarm reporting and acknowledging
3. Time-of-day scheduling
4. Trend data definition and presentation
5. Graphic definition
6. Graphic construction

C. Graphic displays shall be high-resolution, multi-colored presentations of actual building data and parameters. Graphic displays may be quickly and easily viewed via any or all of the following methods as a minimum:

1. Graphic links
2. Drop-down menus
3. Special function keys
4. Points in alarm

D. Graphic links shall be standard symbols, which can be located on graphic displays as desired by the user. These links shall allow the user to view any graphic display, either in a hierarchical fashion or as otherwise defined. The quantity of possible links shall be limited only by the space available on each display.

E. Drop-down menus may be used to view graphic displays by selecting from customized lists, which include all graphics available for viewing. Provide the capability to quickly scroll through all lists.

F. Special function keys shall be used to quickly view graphic alarm displays and user-defined default graphics, such as campus or building site plans. From the alarm display the user may quickly view the graphic on which the associated point in alarm resides.

G. Provide static and dynamic graphic display capabilities. Static displays such as site plans, building layouts, floor plans and schematics shall provide the user with maps to allow for quick and easy access to any building information.

H. Dynamic graphic displays may represent any real-time system information. Any system point or group of points may reside on a dynamic display. Dynamic displays such as schematics of any mechanical system or piece of equipment shall allow the user to monitor and control actual building operating parameters. Point values such as temperature, humidity and flow, and point status such as on/off, normal and alarm shall automatically and continually update to indicate current operating conditions. As a minimum, symbols, text and colors shall be dynamic in nature.

I. Provide functionality to allow for any analog point value to be displayed as an individual dynamic display window for use as a convenient control ad diagnostic tool. The display window shall include the following information as a minimum:

1. Point name
2. Point description
3. Setpoint
4. Current value
5. Range of values
6. High and low limit setpoints

J. All values shall be displayed in both text and symbolic form, such as an analog bar, gauge or other standard measurement device. Setpoint values shall be changed by simply moving a pointer to the desired setting on the measurement device. After user verification of the correct setting the system shall control at the new setpoint. Provide the capability to superimpose these displays on their associated schematic graphics or on separate displays in user-defined groups.

K. Provide the capability to control any point from a dynamic graphic display. Relevant point information windows may be accessed by pointing to a symbol or text. Setpoints may be changed by simply entering the new value. Status may be changed by selecting from predefined lists. The display shall ask the user to verify the change before allowing the system to respond.

L. Provide a graphical spreadsheet-type format for simplification of time-of-day scheduling and overrides of building operations. Provide the following spreadsheet graphic types as a minimum:

1. Weekly schedules
2. Zone schedules
3. Monthly calendars

M. Weekly schedules shall be provided for each building zone or piece of equipment with a specific occupancy schedule. Each schedule shall include columns for each day of the week as well as holiday and special day columns for alternate scheduling on user-defined

days. Equipment scheduling shall be accomplished by simply inserting occupancy and vacancy times into appropriate information blocks on the graphic.

N. In addition, temporary overrides and associated times may be inserted into blocks for modified operating schedules. After overrides have been executed, the original schedule will automatically be restored.

O. Zone schedules shall be provided for each building zone as previously described. Each schedule shall include all commendable points residing within the zone. Each point may have a unique schedule of operation relative to the zone's occupancy schedule, allowing for sequential starting and control of equipment within the zone. Scheduling and re-scheduling of points may be accomplished easily via the zone schedule graphic.

P. Monthly calendars for a 24-month period shall be provided which allow for simplified scheduling of holidays and special days in advance. Holidays and special days shall be user-selected with the pointing device and shall automatically reschedule equipment operation as previously defined on the weekly schedules.

Q. System shall include a Schedule Wizard for set up of schedules. Wizard shall walk user through all steps necessary for schedule generation. Wizard shall have its own pull-down selection for startup or may be started by right clicking on value displayed on graphic and then selecting Schedule.

R. Provide trending capabilities that allow the user to easily monitory and preserve records of system activity over an extended period. Any system point may be trended automatically at time-based intervals or changes of value, both of which shall be user-definable. Trend data may be stored on hard disk for future diagnostics and reporting.

S. Trend data report graphics shall be provided to allow the user to view all trended point data. Reports may be customized to include individual points or pre-defined groups of at least six points. Provide additional functionality to allow any trended data to be transferred easily to an off-the-shelf spreadsheet package such as Lotus 1-2-3. This shall allow the user to perform custom calculations such as energy usage, equipment efficiency and energy costs and shall allow for generation of these reports on high-quality plots, graphs and charts. System server shall periodically gather historically recorded data stored in the building controllers and field controllers and archive the information Archived files shall be appended with new sample data, allowing samples to be accumulated. Systems that write over archived data shall not be allowed, unless limited file size is specified. Samples may be viewed at the operator’s workstation. Operator shall be able to scroll through all trended data. All trend log information shall be displayed in standard engineering units.

T. System shall include a trend Wizard for setup of logs. Wizard shall walk user through all necessary steps. Wizard shall have its own pull-down selection for startup, or may be started by right clicking on value displayed on graphic, and then selecting Trend logs from the displayed menu.

U. System server shall be capable of periodically gathering energy log data stored in the field equipment and archive the information. Archive files shall be appended with new data, allowing data to be accumulated. Systems that write over archived data shall not be allowed unless limited file size is specified. Display all energy log information in

standard engineering units. Operator shall be able to change the energy log setup information as well. This includes the meters to be logged, meter pulse value, and the type of energy units to be logged. All meters monitored by the system may be logged. System shall support using flow and temperature sensors for BTU monitoring.

V. System shall display archived data in tabular format form for both consumption and peak values. Data shall be shown in hourly, daily, weekly, monthly and yearly formats. In each format the user shall be able to select a specific period of data to view.

W. Static graphs shall represent actual point data that has been trended and stored on disk. Exact point values may be viewed on a data window by pointing or scrolling to the place of interest along the graph. Provide capability to print any graph on the system printer for use as a building management and diagnostics tool.

X. Dynamic graphs shall represent real-time point data. Any point or group of points may be graphed, regardless of whether they have been predefined for trending. The graphs shall continuously update point values. At any time the user may redefine sampling times or range scales for any point. In addition, the user may pause the graph and take "snapshots" of screens to be stored on the PC disk for future recall and analysis. As with static graphs, exact point values may be viewed and the graphs may be printed.

Y. Provide a general-purpose graphics package such as PC Paint Plus or IN*A*VISION which shall allow the user to quickly and easily define or construct color graphic displays. In addition, provide a library of standard HVAC equipment and symbols such as air handling units, chillers, cooling towers and boilers and standard electrical symbols that shall aid the user in definition of standard or custom graphics. Additional libraries of standard symbols may be easily added to the package or the user can define or construct symbols as desired for additional customization. Graphic displays may be defined or created to represent any building parameter, mechanical system or group of system points as desired to facilitate building operation and analysis.

Z. Provide the user with the capability to easily define all system operating parameters. Libraries of standard application modules such as temperature, humidity and static pressure control may be used as "building blocks" in defining or creating new control sequences. In addition, the user shall have the capability to easily create and archive new modules and control sequences as desired via a word processing type format. Provide a library of standard forms to facilitate definition of point characteristics. Forms shall be self-prompting and incorporate a fill-in-the-blank approach for definition of all parameters. The system shall immediately detect an improper entry and automatically display an error message explaining the nature of the mistake.

AA. Provide the capability to backup and store all system databases on the PC hard disk. In addition, all database changes may be performed while the PC is on-line without disrupting other system operations. Changes shall be automatically recorded and downloaded to the appropriate DDCP’s. Similarly, changes made at the DDCP’s shall be automatically uploaded to the PC, ensuring system continuity. The user shall also have the option to selectively download changes as desired.

BB. Provide contact-sensitive help menus to provide instructions appropriate with operations and applications currently being performed.

CC. Multiple user security levels shall be provided to allow for various degrees of system access and control. Provide a minimum of four levels of access, with each increasing level allowing control of additional system operations and applications. A minimum of twelve unique passwords, including user initials shall be provided. The system shall automatically generate a report of log-on/log-off time and system activity for each user. Provide automatic log-off capability to prevent unauthorized system use. Automatic log-off time shall be user-definable in one-minute increments and may be disabled if desired.

DD. Graphics shall be constructed for individual monitoring of the building systems, and shall include data from all points in the sequence of operations and the input/output summary. Graphics shall be created by the BMCS contractor to monitor the following systems:

1. An individual graphic for each Air Handling Unit System, including rooftop air handlers, fan-powered terminals, cabinet unit heaters, etc.
2. The boiler/heating plant including the pumps.
3. Chiller and Chilled water flow.
4. Floor plans for each floor.
5. Overall building.

2.6 FIELD ENGINEERING TOOLS

A. Operator's workstation software shall include field-engineering tools for programming all controllers supplied. All controllers shall be programmed using graphical tools that allow the user to connect function blocks on screen that provide sequencing of all control logic. Function blocks shall be represented by graphical displays that are easily identified and distinct from other types of blocks. Graphical programming that uses simple rectangles and squares is not acceptable.

B. User shall be able to pick graphical function block from menu and place on screen. Provide zoom in and zoom out capabilities. Function blocks shall be downloaded to controller without any reentry of data.

C. Programming tools shall include a real time operation mode. Function blocks shall display real time data and be animated to show status of data inputs and outputs when in real time operation. Animation shall show change of status on logic devices and countdown of timer devices in graphical format.

D. Field engineering tools shall also include a database manager of applications that include logic files for controllers and associated graphics. Operator shall be able to select unit type, input/output configuration and other items that define unit to be controlled. Supply minimum of 250 applications as part of workstation software.

E. Field engineering tool shall include Device Manager for automatic detection of devices connected anywhere on the BACnet network by scanning of the entire network. This function shall display device instance, network identification, model number and description of connected devices. It shall record and display software file loaded into each controller. A copy of each file shall be stored on the computers hard drive. If needed, this file shall be downloaded to the appropriate controller by selection using the mouse.

F. System shall include backup/restore function that will back up entire system to selected medium and then restore system from that media.

2.7 BUILDING CONTROLLER – GLOBAL

A. All communication with operator workstation and all programmable controllers shall be via BACnet. Building controller shall incorporate as a minimum, the functions of a 3-way BACnet router. Controller shall route BACnet messages between the high-speed LAN (Ethernet 10/100MHz), at least 4 master slave token passing (MS/TP) LANs, a point-to-point (PTP – RS-232) connection and an on-board modem.

B. Each MS/TP LAN must be software configurable from 9.6 to 76.8Kbps.

C. The RJ-45 Ethernet connection must accept either 10Base-T or 100Base-TX BACnet over twisted pair cable (UTP).

D. The direct access port must be a female DB-9 connector supporting BACnet temporary PTP connection of a portable BACnet operator terminal at 9.6 to 115.2 Kbps over RS-232 null modem cable.

E. Building controller shall be capable of providing global control strategies for the system based on information from any objects in the system regardless if the object is directly monitored by the controller or by another controller. The program that implements these strategies shall be completely flexible and user definable. Any systems utilizing factory pre-programmed global strategies that cannot be modified by field personnel on-site or downloaded via remote communications are not acceptable. Changing global strategies via firmware changes is also unacceptable.

F. Programming shall be object-oriented using control function blocks, supporting DDC functions, 1000 Analog Values and 1000 Binary Values.. All flowcharts shall be generated and automatically downloaded to controller. Programming tool shall be resident on workstation and the same tool used for all controllers.

G. Provide means to graphically view inputs and outputs to each program block in real-time as program is executing. This function may be performed via the operator’s workstation or field computer.

H. Building controller shall provide battery-backed real-time (hardware) clock functions.

I. Controller shall have a memory needed to ensure high performance and data reliability. Battery shall retain static RAM memory and real-time clock functions for a minimum of 1.5 years (cumulative).

J. Global control algorithms and automated control functions should execute via 32-bit processor.

K. Controller installation shall include memory-free gel-cell battery providing ongoing power conditioning and noise filtering for operation data integrity. It shall provide up to 5 minutes of powerless operation for orderly shutdown and data backup.

L. BACnet Conformance

1. Building Controller shall as a minimum support Point-to-Point (PTP), MS/TP and Ethernet BACnet LAN types. It shall communicate directly via these BACnet LANs as a native BACnet device and shall support simultaneous routing functions between all supported LAN types. Global controller shall be a BACnet conformance class 3 device and support all BACnet services necessary to provide the following BACnet functional groups:

    a. Clock Functional Group
    b. Files Functional Group
    c. Reinitialize Functional Group
    d. Device Communications Functional Group
    e. Event Initiation Functional Group

2. Standard BACnet object types supported shall include as a minimum: Analog Value, Binary Value, Calendar, Device, File, Group, Notification Class, Program and Schedule object types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

3. The Building Controller shall comply with Annex J of the BACnet specification for IP connections. This device shall use Ethernet to connect to the IP internet work, while using the same Ethernet LAN for non-IP communications to other BACnet devices on the LAN. Must support interoperability on wide area networks (WANs) and campus area networks (CANs) and function as a BACnet Broadcast Management Device (BBMD).

M. Remote Communications

1. Provide all functions that will allow remote communications via the Owner's Intranet to off-site locations. Remote Access to the system will utilize a central WEB server. This WEB server will not be the same component utilized for the operator workstation.
2. Utilize IT Standard Netscape or Internet Explorer that allows operator to view and change all information associated with system on color graphic displays. Operator shall be able to change all parameters in this section from off-site location including all programming of building controllers and all programmable controllers including all terminal unit controllers.
3. Building controller shall have capability to call out alarm conditions automatically. If desired, controller may also send encoded message to digital pager. If an alphanumeric pager is in use by the operator, building controller shall be capable of sending a text or numeric string of alarm description. All building controllers connected to the local LAN
4. Building controller shall have capability to call a minimum of 20 different phone numbers. Numbers called may be controlled by type of alarm or time schedule.
5. Building controller and internal modem shall be capable of modem-to-modem baud rates of 33.6 Kbps minimum over standard voice-grade phone lines. Lower baud rates shall be selectable for areas where local phone company conditions require them.

N. Schedules

1. Each building controller shall support a minimum of 250 BACnet Schedule Objects and 250 BACnet Calendar Objects.

O. Logging Capabilities

1. Each building controller shall log as minimum 1000 trend logs. Any object in the system (real or calculated) may be logged. Sample time interval shall be adjustable at the operator's workstation.
2. Logs may be viewed either on-site or off-site via remote communication.
3. Building controller shall periodically upload trended data to networked operator's workstation for long term archiving if desired.
4. Archived data stored in database format shall be available for use in third-party spreadsheet or database programs.

P. Alarm Generation

1. Alarms may be generated within the system for any object change of value or state either real or calculated. This includes things such as analog object value changes, binary object state changes, and various controller communication failures.
2. Each alarm may be dialed out as noted in paragraph 2 above.
3. Alarm log shall be provided for alarm viewing. Log may be viewed on-site at the operator's terminal or off-site via remote communications.
4. Controller must be able to handle up to 1500 alarm setups stored as BACnet event enrollment objects – system destination and actions individually configurable.

2.9 DISTRIBUTED CONTROL PANEL (DDCP)

A. The system shall utilize intelligent distributed digital control panels (DDCP) to interface with sensors being monitored and equipment being controlled by the building management and control systems. Provide one or more native BACnet programmable controllers for each air handler and provide native BACnet programmable controllers as needed for central plant control that adequately cover all objects listed in object list. All controllers shall interface to building controller via MS/TP LAN using BACnet protocol. No gateways shall be used. Controllers shall include input, output and self-contained logic program as needed for complete control of units. Controllers shall be fully programmable using graphical programming blocks. Programming tool shall be resident on operator workstation and be the same tool as used for the building controller and remain on the workstation. "***Configurable" controllers that are not fully programmable will not be accepted. No auxiliary or non-BACnet controllers shall be used. Proprietary or LON protocols will not be accepted.***

B. Controllers shall as a minimum support MS/TP BACnet LAN types. They shall communicate directly via this BACnet LAN at 9.6, 19.2, 38.4 and 76.8 Kbps, as native BACnet devices. Controllers shall be of BACnet conformance class 3 and support all BACnet services necessary to provide the following BACnet functional groups:
1. Files Functional Group

2. Reinitialize Functional Group
3. Device Communications Functional Group

C. Controllers shall include universal inputs with 10-bit resolution that accept 3K and 10K thermistors, 0–10VDC, 0–5 VDC, 4–20 mA and dry contact signals. Any input on a controller may be either analog or digital with a minimum of 3 inputs that accept pulses. Controller shall also include support and modifiable programming for interface to intelligent room sensor with digital display. Controller shall include binary and analog outputs on board. Analog outputs shall be switch selectable as either 0–10VDC or 0–20mA. Software shall include scaling features for analog outputs. Application controller shall include 24VDC voltage supply for use as power supply to external sensors.

D. Each DDCP shall execute all application programs, calculations and commands via a 16-bit microcomputer resident in the panel. The microcomputer shall permit floating point calculations to enable the performance of energy calculations.

E. All program sequences shall be stored on board application controller in EEPROM. No batteries shall be needed to retain logic program. Controller shall execute all program sequences 10 times per second and capable of multiple PID loops for control of multiple devices. All calculations shall be completed using floating-point math and system shall support display of all information in floating-point nomenclature at operator’s terminal. Programming of application controller shall be completely modifiable in the field over installed BACnet LANs or remotely via modem interface. Operator shall program logic sequences by graphically moving function blocks on screen and tying blocks together on screen. Application controller shall be programmed using programming tools as described in operator’s terminal section.

F. Each DDCP shall be capable of full operation either as a completely independent panel or as a part of the existing building-wide control system. All panels shall contain the necessary equipment for direct interface to the sensors and actuators connected to it. The DDCP network shall be able to detect changes in any DDC panel point status and report these changes to all terminals accessing the building-wide network.

G. Each DDCP shall include its own microcomputer direct digital controller, power supply, input/output modules, communications board, two (2) RS-232 communications port, and battery. The DDCP shall have built-in diagnostics to display at any operator's terminal the amount of available RAM in each DDCP on the network. Each DDCP shall perform continuous diagnostics, and any malfunction shall be annunciated at the operator's console as well as visually indicated at the DDC panel.

H. Failure of any DDCP on the system shall not affect the proper operation of the remaining system components.

I. The system shall be capable of phased start-up. That is, any DDCP shall be capable of properly communicating with the rest of the system while remaining panels are being installed.

J. UL Listings for each DDCP shall be UL916 (Energy Management Systems), UL864-OUDTZ (Signal Systems Unit). Units shall be tested to comply with sub-part J of Part 15 FCC rules for Class A computing equipment.

K. Cabinet for each DDCP shall be all metal construction NEMA 1 construction. Each panel, including cabinet, power supply, function cards and termination modules, shall be UL approved. Each panel shall have a pin-hinged door and master keyed lock.

L. Each DDCP shall be capable of proper operation in an ambient environment of 32 to 120 degrees F and 10 to 90% RH.

M. The DDCP shall be furnished with a user programmable language and internal memory of at least 128Kb RAM for local storage of extended trend data.

N. Controller shall include support for intelligent room sensor. Display on intelligent room sensor shall be programmable at application controller and include an operating mode and a field service mode. All button functions and display data shall be programmable to show specific controller data in each mode based on which button is pressed on the sensor. See sequence of operation for specific display requirements at intelligent room sensor.

2.10 DDCP PROGRAMMING FUNCTIONS

A. Resident software in the DDCP shall provide for custom programming of control strategies, point database, operator interface, network communications, facilities and energy management functions.

1. Programming of control and energy management strategies shall be accomplished via a high level computer language such as BASIC. A standard math processor shall be part of the programming language. All analog loops shall be capable of proportional, integral, and derivative control.
2. Operator Interface Program (OIP) that allows an English language user interface shall be provided with each DDCP. The OIP shall allow the user to program, interrogate, command and edit future DDCP's that may be added to the network via a self-prompting method. Operator terminals, whether textual or graphical, shall be able to access any future network additions from any DDCP and any DDCP within the existing facility. Access shall be accomplished in a transparent fashion; that is, the operator shall not be required to address specific DDCP's in order to display or command system points.

B. Resident software in the DDCP shall provide for custom programming of control strategies, point database, operator interface, network communications, facilities and energy management functions.

1. Programming of control and energy management strategies shall be accomplished via a high level computer language such as BASIC. A standard math processor shall be part of the programming language. All analog loops shall be capable of proportional, integral, and derivative control.

2. Operator Interface Program (OIP) that allows an English language user interface shall be provided with each DDCP. The OIP shall allow the user to program, interrogate, command and edit future DDCP's that may be added to the network via a self-prompting method. Operator terminals, whether textual or graphical, shall be able to access any future network additions from any DDCP and any DDCP within the existing facility. Access shall be accomplished in a transparent

fashion; that is, the operator shall not be required to address specific DDCP's in order to display or command system points.

2.11 USER PROGRAMMABILITY

A. All temperature control strategies and energy management routines shall be definable by the operator through an operator interface device connected to any DDCP. The system shall be provided complete with all equipment, software and documentation necessary to allow a trained operator to independently perform the functions listed below.

1. Read the value of a measure variable (i.e., temperature).
2. Start or stop equipment.
3. Monitor the status of equipment being controlled.
4. Read the set point of a control loop.
5. Determine the control strategies that have been defined for a specific piece of equipment.
6. Generate displays of control strategies.
7. Add/delete control loops to the system.
8. Add/delete points to the system.
9. Create, modify or delete control strategies.
10. Assign sensors and/or actuators to a control strategy.
11. Tune control loops through the adjustment of control loop parameters.
12. Enable or disable control strategies.
13. Select points to be alarmable and define the alarm state(s).

B. Self-diagnostics that continuously monitor the proper operation of each DDCP unit shall be built into each unit. A malfunction of the DDCP shall be reported, and shall inform the operator of the nature of the malfunction and the panel affected. It shall be possible to annunciate malfunctions as well as other DDCP alarms at a selected operator's terminal.

2.12 DDCP SOFTWARE

A. Each DDCP shall be capable of independently performing the following control and energy management routines as a minimum:

1. Time of day scheduling.
2. Start/stop time optimization.
3. Economizer control.
4. Enthalpy changeover.
5. Outdoor air reset.
6. Event initiated programs.
7. Trending.
8. Power demand limiting.

B. In addition, each DDCP unit shall independently support the creation and modification of custom direct control algorithms based on arithmetic, Boolean or time-based logic. Each panel shall support the creation, modification or removal of control algorithms while operating. Such functions shall be programmed using a sequential, numbered-statement programming language. Each control loop shall be fully user definable as follows:

1. Sensors and actuators.
2. Control mode (proportional, integral, derivative, or combinations thereof).
3. Gains.
4. Control action.
5. Sampling time.

C. All temperature control functions shall be executed within the DDCP. Loop control shall be executed via direct digital control algorithms. The user shall be able to customize control strategies and sequences on control and shall be able to define appropriate control loop algorithms and choose the optimum loop parameters for loop control. All control loops provided under this contract shall be properly tuned P.I.D. control loops. If the network communication link fails or the other DDCP malfunctions, the control loop shall continue to function using the last value received from the DDCP.

D. The system shall allow custom control algorithms to be created locally within the DDCP via a portable-operator terminal, and centrally in the central console.

E. Resident software, which allows user interface using simple menus and single letter commands shall be, supplied standard with each DDCP. This software shall require the operator to have knowledge of specific point addresses or other such system-specific information to allow access. Solutions, which require basic user interface software to be resident in personal computers or other extra devices, will not be acceptable.

F. The system shall permit the generation of the job- specific control strategies that can be activated in any of the following ways:

1. Continuously.
2. At a particular time of day.
3. When a specific measured or controlled variable reads a selected value or state.
4. When a piece of equipment has run a certain period of time.

2.13 TERMINAL EQUIPMENT CONTROLLER (Such as Rooftop Units, DOAS Units, AC Units, etc.)

A. Provide one native BACnet terminal equipment controller for each piece of unitary mechanical equipment that adequately covers all objects listed in object list for unit. All controllers shall interface to building controller via MS/TP LAN using BACnet protocol. No gateways shall be used. Controllers shall include input, output and self-contained logic program as needed for complete control of unit. ***Controllers will be fully programmable. "Configurable" controllers that are not fully programmable will not be accepted.***

B. BACnet Conformance

1. Application controllers shall as a minimum support MS/TP BACnet LAN types. They shall communicate directly via this BACnet LAN at 9.6, 19.2, 38.4 and 76.8 Kbps, as a native BACnet device. Application controllers shall be of BACnet conformance class 3 and support all BACnet services necessary to provide the following BACnet functional groups:

a. Files Functional Group

b. Reinitialize Functional Group
c. Device Communications Functional Group

2. Standard BACnet object types supported shall include as a minimum–Analog Input, Analog Output, Analog Value, Binary Input, Binary Output, Binary Value, Device, File and Program Object Types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

C. Controllers shall include universal inputs with 10-bit resolution that can accept 3K and 10K thermistors, 0–5 VDC, 4–20 mA, dry contact signals and a minimum of 3 pulse inputs. Any input on controller may be either analog or digital. Controller shall also include support and modifiable programming for interface to intelligent room sensor. Controller shall include binary outputs on board with analog outputs as needed.

D. All programs sequences shall be stored on board controller in EEPROM. No batteries shall be needed to retain logic program. All program sequences shall be executed by controller 10 times per second and shall be capable of multiple PID loops for control of multiple devices. Programming of application controller shall be completely modifiable in the field over installed BACnet LANs or remotely via modem interface. Operator shall program logic sequences by graphically moving function blocks on screen and tying blocks together on screen. Application controller shall be programmed using same programming tools as building controller and as described in operator workstation section. All programming tools shall be provided and installed as part of system.

E. Controllers shall include all point inputs and outputs necessary to perform the specified control sequences. As a minimum, 50% of the point outputs shall be of the Universal type; that is, the outputs may be utilized either as modulating or two-state, allowing for additional system flexibility. In lieu of Universal outputs, provide a minimum of 50% spare outputs to each type via additional point termination boards or controllers. Analog outputs shall be industry standard signals such as 24V floating control, allowing for interface to a variety of modulating actuators. Terminal Equipment Controllers utilizing proprietary control signals and actuators shall not be acceptable.

F. Each controller performing space temperature control shall be provided with a matching room temperature sensor. The sensor may be either RTD or thermistor type.

1. Each room temperature sensor shall include a terminal jack integral to the sensor assembly. The terminal jack shall be used to connect a portable laptop or similar operator's terminal to control and monitor all hardware and software points associated with the controller. In lieu of an internal jack, provide a separate terminal jack mounted on a stainless steel wall plate adjacent to the sensor to facilitate direct access to the controller via the terminal.
2. Each room sensor shall also include the following auxiliary devices:

a. Setpoint Adjustment Dial
b. Override Switch

3. The setpoint adjustment dial shall allow for modification of the temperature by the occupant. Setpoint adjustment may be locked out, overridden or limited as to

time or temperature through software by an authorized operator at the central workstation, DDCP or via the portable programming tool. In lieu of an integral adjustment dial, provide a separate dial mounted on a stainless steel wall plate adjacent to the sensor to perform the specified functionality.

4. The override switch shall initiate override of the night setback mode to normal (day) operation when activated by the occupant. The override function may be locked out, overridden or limited as to the time through software by an authorized operator at the central workstation, DDCP or via the portable programming tool. In lieu of an integral switch, provide a separate momentary contact switch mounted on a stainless steel wall plate adjacent to the sensor to perform the specified functionality.

G. Each controller shall perform its primary control function independent of other DDCP network communication, or if network communication is interrupted. Reversion to a fail-safe mode of operation during network interruption is not acceptable. Should the controller reside on a DDCP network, the controller shall receive its real-time data from the DDCP clock to insure network continuity. Each controller shall include algorithms incorporating proportional, integral and derivative (PID) gains for all applications. All PID gains and biases shall be field-adjustable by the user via terminals as specified herein. This functionality shall allow for tighter control of space conditions and shall facilitate optimal occupant comfort and energy savings. Controllers that incorporate proportional and integral (PI) control algorithms only shall not be acceptable.

H. Provide each terminal equipment controller with sufficient memory to accommodate point databases, operating programs, local alarming and local trending. All databases and programs shall be stored in non-volatile EEPROM, EPROM and PROM. The controllers shall be able to return to full normal operation without user intervention after a power failure of unlimited duration. Provide uninterruptible power supplies (UPS’s) of sufficient capacities for all terminal controllers that do not meet this powerful protection requirement. In addition, specific applications may be modified to meet the user's exact control strategy requirements, allowing for additional system flexibility. Controllers that require factory changes of all applications are not acceptable.

I. Each controller shall have connection provisions for a portable laptop or similar operator's terminal. This connection shall be possible at either the controller or at the matching room temperature sensors as previously specified. The terminal may be used for readout of system variables, override control, adjustment of control parameters, air balancing, servicing and troubleshooting. The terminal shall provide the user with the following functionality as a minimum:

1. Display system status (heating, cooling, etc.)
2. Display all point values and setpoints
3. Set and change all setpoints
4. Set and change heating/cooling deadbands
5. Set and change PID loop gains
6. Set and change system mode (occupied/unoccupied)
7. Set and change system mode lines
8. Override all setpoints
9. Override all digital and analog outputs
10. Command all digital and analog outputs
11. Select application mode

12. Assign controller address

J. Controllers shall support the following library of control strategies to address the requirements of the sequences described in the "Execution" portion of this specification, and for future expansion:

1. Daily Schedules
2. Comfort/Occupancy Mode
3. Economy Mode

   a. Standby Mode/Economizer Available
   b. Unoccupied Mode/Economizer Not Available
   c. Shutdown

4. Lighting Logic Interlock to Economy Mode
5. Temporary Override Mode

   a. Temporary Comfort Mode (Occupancy-Based Control)
   b. Boost (Occupant Warmer/Cooler Control)

2.14 FIELD DEVICES AND SENSORS/INPUT DEVICES TO DDCP's

A. Room: All space temperature sensors, which are used, as inputs to the DDCP's shall be the thermistor or RTD type. The range shall be 40 - 120 degrees F. at a factory calibration point of 77 degrees F. Accuracy shall be ± 0.5 degrees F at calibration point. Sensors will include local setpoint adjustment with +\- two degree F programmable, timed override. Sensors will include digital display including actual temperature and space temperature setpoint.

B. Single point duct temperature sensors shall be the thermistor or RTD type. The range shall be 40 - 150 degrees F with a factory calibration point of 77 degrees F. Accuracy shall be ± 0.5 degrees F at calibration point. These sensors shall be used in unit discharge and return air ducts.

C. Averaging element sensors shall be the thermistor type to eliminate any necessary calibration adjustment for wiring length. The range shall be 20 - 120 degrees F at a factory calibration point of 70 degrees F. Accuracy of the sensor at calibration point shall be ± 1.1 degrees F. These sensors shall be used in unit mixed air or preheat coil discharge sections.

D. Outside air temperature sensor shall be the thermistor type to eliminate any necessary calibration adjustment for wiring length. The range shall be -58 - 122 degrees F and have accuracy at calibration point ± 0.5 degrees F.

E. Low temperature detectors (freezestats) shall be the manual reset type, two-position snap acting. Capillary shall have minimum sensitive length of 20 feet and shall be installed in serpentine fashion downstream from coil it is protecting. Each square foot of coil shall be protected by a section of the capillary. Where large coil size or multiple coil construction exceeds the limit of coverage of one unit, provide additional units placed in series to that coil area coverage is maintained. ***Acceptable manufacturers are Penn or Honeywell only.***

F. Room Humidity sensors shall be commercial grade with standard 4 - 20 ma outputs. The range shall be 0 -99% RH. Stated accuracy shall be + 2% RH minimum.

G. Duct-mounted humidity sensors shall be commercial grade with 4-20 MA output, range shall be 0-99% RH accuracy will be +\- 6% minimum. Will be mounted within manufacturers enclosure on ductwork.

H. CO_2 Sensors: Sensors shall use single or dual-beam absorption infrared diffusion technology (non-dispersive infrared), and shall have integral programming to perform automatic baseline calibration without user interface. The recommended manual recalibration period shall not be less than five years. Sensors shall meet or exceed the following specifications.

I. Water temperature sensors shall be well-mounted insertion liquid temperature sensor, platinum element with a 10K ohm signal transmitted to the DDCP. The ranges used shall be appropriate with the application. The range applied for sensing hot water temperature shall be 70-220 degrees F and for sensing chilled and condenser water temperatures shall be 20-120 degrees F.

J. Differential Pressure Switches: The differential pressure range of the switch shall be selected to suit the application and shall have an adjustable set point. The switch shall have SPDT contacts rated at 9 amperes at 120 volt AC and be UL approved. The switch shall be mounted with the diagram in a vertical plan. The switch shall be capable of withstanding full system pressure on either side of the sensing element with atmospheric pressure on the other side, without damage to the switch or degradation of its calibration.

K. Liquid Detection Switch (Drain Pans) : Normally energized when the power supply is switched on. Components shall be fully encapsulated against moisture ingress.
Switching capable of 5A at 240VAC

L. Temperature, Pressure, Flow and Level Transmitters: Transmitters shall produce a 4 to 20 mA output linearly proportional to the measured variable, with a minimum accuracy of .5% of the transmitter range. The range shall not exceed 200% of the measured variable's normal maximum value.

M. Duct (or System) Static Pressure Measuring Devices: Provide, where indicated, duct static measuring devices capable of continuously monitoring the duct or system static pressure it serves. The pressure range of the switch shall be selected to suit the application and shall have an adjustable set point and deadband. The switch shall have at least one SPDT contact rated at 9 amperes at 120 volt AC and be UL approved.

N. The duct static traverse probe shall be of extruded aluminum construction and (except for 3/4" diameter probes with lengths of 24" or less) be complete with threaded end support rod, sealing washer and nut, and mounting plate with gasket and static pressure signal fitting. The static traverse probe shall be capable of producing a steady, non-pulsating signal of standard static pressure, without need for correction factors, with an instrument accuracy of 0.5%.

O. Pressure Transmitters shall be the 4 - 20 ma output type with zero and span adjustments. The range shall be 0-00.5", 0-1", 0-2", 0-5", or 0-10" w.c. as required by the application.

Combined static error (non-linearity and hysteresis) shall be ± 1% of full range output. Transmitters shall be supplied to transmit a 4-20 ma signal to the DDCP for every flow measuring station and duct static pressure traverse probe.

P. Dewpoint Sensor: As manufactured by Sauter, will be provided by chilled beam manufacturer.

Q. Air Flow Monitoring

1. Provide combination airflow and air temperature measurement devices where required. Fan inlet sensors shall not be substituted for duct or plenum sensor probes indicated on the plans.
2. Each measuring device shall consist of multi-point sensors in one or more probe assemblies per location, and a single remotely mounted microprocessor-based transmitter for each measurement location. Each transmitter shall operate on 24 VAC and be fused and protected from over voltage, over current and power surges. All integrated circuitry shall be temperature rated as 'industrial-grade'. No electronic components other than the sensor elements shall be located at the sensing node. Each ducted sensor probe shall have an integral, U.L. Listed, plenum rated cable. Conductor insulation for internal probe wiring shall be made from Kynar.
3. Each sensing point shall independently determine the airflow rate and temperature at each node, which shall be equally weighted in calculations by the transmitter prior to output as the cross-sectional average. Devices which average multiple non-linear variables are not acceptable. Pitot arrays are not acceptable. Devices using chip-in-glass, epoxy-coated or diode-case chip thermistors are not acceptable. Vortex-shedding devices are not acceptable.
4. Each independent airflow sensor node shall have a laboratory accuracy of +/-2% of Reading over the entire calibrated airflow range of 0 to 5,000 fpm (25.4 m/s) for ducted or plenum mounted probes, or not less than 0 to 10,000 fpm (50.8 m/s) for fan inlet mounted sensors. All sensor nodes shall be wind tunnel calibrated or field-verified against air velocity standards that are traceable to NIST.
5. Devices whose accuracy is the combined and independent accuracy of the transmitter and sensor probes must demonstrate that the total accuracy meets the performance requirements of this specification throughout the calibrated range.
6. Each independent temperature sensor node shall have a calibrated accuracy of +/-0.14° F (0.08° C) over the entire operating temperature range of -20° F to 160° F (-28.9° C to 71° C).and be calibrated or field-verified against temperature standards that are traceable to NIST.
7. Airflow/Temperature measuring devices shall be UL Listed as an entire assembly. Devices in UL-labeled enclosures are not equivalent and are not acceptable without a UL Listing.
8. Where fan inlet measurement is required, mounting styles shall be indicated on the plans as either "face mounting" or "throat mounting." Face mounting shall provide no mechanical fastening in the throat or on the surface of the inlet cone and shall be used on all performance-sensitive plenum-type or plug fans.
9. Acceptable Manufacturers: EBTRON, Inc. (basis of design)

R. Current Sensing Switch

1. The current sensing switch shall be self-powered with solid state circuitry and a dry contact output. It shall consist of a current transformer, a solid state current sensing circuit, adjustable trip point, solid state switch, SPDT relay, and an LED indicating the on or off status. A conductor of the load shall be passed through the window of the device. It shall accept over-current up to twice its trip point range.
2. Current sensing switches shall be used for run status for fans, pumps, and other miscellaneous motor loads.
3. Current sensing switches shall be calibrated to show a positive run status only when the motor is operating under load. A motor running with a broken belt or coupling shall indicate a negative run status.

S. Air Pressure Safety Switches

1. Air pressure safety switches shall be of the manual reset type with SPDT contacts rated for 2 amps at 120VAC.
2. Pressure range shall be adjustable with appropriate scale range and differential adjustment for intended service.

T. Control Dampers

1. Furnish for installation by the sheet metal contractor, standard dampers suitable for use in temperatures from -50 degrees F to 200 degrees F. Frames shall be 5" x 1" x 16 gage aluminum hat channel
2. Dampers shall be of the galvanized dual blade type with linear stroke operators complete with motors. Blade action must be opposed. Straight blade type dampers are not acceptable. Blades shall be roll formed, airfoil double thickness 16 gage galvanized steel blades, maximum of 6" wide. Axles shall be 1/2" plated steel hex. Bearings shall be molded synthetic and linkage concealed in frame.
3. Maximum single section shall be 48" wide and 72" high. When applications require more than one damper section to fill opening, appropriate jack shifting shall interconnect sections.
4. Leakage factor in the closed position shall not exceed 0.001% of the normal rated airflow at 4" static pressure differential across the damper.
5. Extruded neoprene gaskets shall be provided to seal all mating surfaces. Blade edge seals shall be extruded dual durometer vinyl. The gaskets shall be field replaceable and carry a 10-year material replacement warranty. Jamb seals shall be flexible metal, compression type.
6. Damper discs and frames shall be constructed of formed galvanized steel. Linkage components shall be galvanized steel and aluminum. All shafting must be stainless steel with the exception of standard actuator-shafts. Critical rotating surfaces shall be protected by nylon bushings.
7. Dampers shall be similar to Ruskin Model CD-50/60.

U. Control Damper Actuators

1. Electronic damper operators shall be located outside the air stream whenever possible. All damper motors shall be spring return type and be of sufficient size to operate their respective dampers effectively.

V. Control Valves – Other Than Reheat/Radiation Valves

1. Control voltage shall be chosen by the BAS contractor to be compatible with this control system.
2. All heating valves will be fail safe, open to flow water through the heating coil.
3. Spring return, electronic motor actuators shall position control valves. All valves shall have shutoff discs and V-ring packing. Valve sizes of 1/2 through 2 inches shall be furnished with screwed or soldered ends with stainless steel or bronze trim to suit the application.
4. Flanged valves with bronze trim shall be furnished for sizes 2 1/2 inch and larger.
5. Lug type butterfly valves with bronze discs and disc seals suitable for the medium and expected temperature range may be used for valve sizes of 5 inch or larger provided that the control signal for modulating valve applications employs both proportional and integral algorithms. The minimum rating for valve bodies shall be ANSI class 125.
6. Diverting Valves shall be used in 3-way water diverting applications. 3-way Mixing valves will not be used in diverting applications.
7. The BAS contractor shall size each control valve to provide the proper flow rate at the available differential pressure, and shall include the Cv of each valve in his submittal. Sizing control valves based on pipeline size is not acceptable.

W. Reheat and Radiation Valves

1. The reheat electronic actuator shall mount on the valve body and provide complete modulating control of the valve.
2. Radiation and Radiant Panels with water flow of less than 4 gallons will be two position. Radiation or radiant panels with 4 gallons or above will be modulating.
3. The electronic actuator will require 24VAC.
4. The valves shall be bronze body with stainless steel trim. The minimum rating for valve bodies shall be ANSI class 125.

X. Thermostats

1. Electric room thermostats of the heavy-duty type shall be provided for unit heaters, cabinet unit heaters, and ventilation fans, where required. All these items shall be provided with concealed adjustment. Finish of covers for all room-type instruments shall match and, unless otherwise indicated or specified, covers shall be manufacturer’s standard finish.

Y. Pilot Relays

1. Shall be of modular plug in design with retaining springs or clips.
2. Mounting base shall be snap mount
3. Contacts shall be rated for 10 amps at 120 VAC
4. Shall have a visual indicator light

Z. Local Control Panels

1. All control panels shall be factory constructed, incorporating the DDC manufacturers standard designs and layouts (coordinate with control contractor). All control panels shall be UL inspected and listed as an assembly and carry a

UL 508 label listing compliance. Control panels shall be fully enclosed, with sub-panel, hinged door, and key-locking latch.

2. In general, the control panels shall consist of the DDC controller(s), display module, and I/O devices—such as relays, transducers, and so forth—that are not required to be located external to the control panel due to function. The display module shall be flush mounted in the panel face unless otherwise noted.
3. All I/O connections on the DDC controller shall be extended to a numbered, color-coded, and labeled terminal strip for ease of maintenance and expansion. Wiring to I/O devices shall be made from this terminal strip.
4. All other wiring in the panel, internal and external, shall be made to additional line or low voltage color-coded and labeled terminal strips. Low and line voltage wiring shall be segregated. All terminal strips and wiring shall be UL listed, 300-volt service and provide adequate clearance for field wiring.
5. All wiring for every control panel shall follow a common color-coded format. All terminal strip color coding and numbering shall follow a common format. All wiring shall be neatly installed in plastic trays or tie-wrapped.
6. A convenience 120 VAC duplex receptacle shall be provided in each enclosure, fused on/off power switch, and required transformers.

AA. Variable Frequency Drives

1. The variable frequency drives (VFD) shall be manufactured by Asea Brown Boveri (ABB), designated ACH series, or engineer approved equal.
2. Construction

a. The VFD shall be solid state, with a Pulse Width Modulated output. The VFD shall employ a full wave rectifier (to prevent input line notching), Integral Line Reactor (s), DC bus filter capacitors, and Insulated Gate Bipolar Transistors (IGBT's) as the output switching device. The drive efficiency shall be 97% or better at full speed and full load. Fundamental power factor shall be 0.98 at all speeds and loads.
b. The VFD shall be housed in a NEMA 1 enclosure.
c. Standard operating conditions will include:

1) Input 380/415/440/460/480 VAC +/-10 %, 3 phase, 48-63 Hz or input 200/208/220/230/240 VAC +/- 10%, 3 phase, 48-63 Hz.
2) Output frequency 0 to 250 Hz. Operation above 60 Hz shall require programming changes to prevent inadvertent high-speed operation.

d. All VFDs will include:

1) All VFDs shall have the same customer interface, including digital display, and keypad, regardless of horsepower rating. The keypad is to be used for local control, for setting all parameters, and for stepping through the displays and menus. The keypad shall be removable, capable of remote mounting and shall have it's own non-volatile memory. The keypad shall allow for uploading and downloading of parameter settings as an aid for start-up of multiple VFD’s.

2) The key pad shall include Hand-Off-Auto membrane selections. When in “Hand”', the VFD will be started and the speed will be controlled from the up/down arrows. When in “Off”', the VFD will be stopped. When in “Auto”, the AFD will start via an external contact closure and the VFD speed will be controlled via an external speed reference. The drive shall incorporate "bumpless transfer" of speed reference when switching between "Auto" and "Hand” modes.

3) Shall utilize pre-programmed application macro's specifically designed to facilitate start-up. The Application Macros shall provide one command to reprogram all parameters and customer interfaces for a particular application to reduce programming time.

4) Shall have the ability to automatically restart after an overcurrent, overvoltage, undervoltage, or loss of input signal protective trip. The number of restart attempts, trial time, and time between reset attempts shall be programmable.

5) Capable of starting into a rotating load (forward or reverse) and accelerate or decelerate to setpoint without safety tripping or component damage (flying start). The VFD’s shall also be capable of DC injection braking at start to stop a reverse spinning motor prior to ramp.

6) Terminal strips shall be isolated from the line and ground.

7) The drive shall employ current limit circuits to provide trip free operation.

8) Shall have an integral line reactor to reduce the harmonics to the power line and to increase the fundamental power factor.

9) Capable of sensing a loss of load (broken belt / no water in pump) and signal the loss of load condition. The drive shall be programmable to signal this condition via a keypad warning, relay output, and/or over the serial communications bus. Relay outputs shall include programmable time delays that will allow for drive acceleration from zero speed without signaling a false underload condition.

10) Speed input shall be via

    a) Keypad
    b) Analog Input (4-20mA or 0-10vdc)

11) Serial Communications

    a) The VFD shall have an RS-485 port as standard. The standard protocol shall be BACnet.
    b) The VFD shall be able to communicate with PLC’s, DCS’s, and DDC’s using standard MS/TP.

12) Compliance to IEEE-519

    a) The VFD manufacturer is responsible for the cost of all equipment required to meet IEEE-519-1992, General Category, at no additional costs to the user. Equipment

which can be provided include AC input line reactors, DC bus reactors and/or harmonic trap filters. In order to determine what harmonic filtering equipment is required, the VFD manufacturer must conduct a harmonics analysis of the site prior to the bid.

PART 3 – PERFORMANCE / EXECUTION

3.1 COMMISSIONING OF SYSTEMS AND EQUIPMENT

A. Engage a factory-authorized service representative or technician who is familiar with this project to participate and assist, if necessary, in the functional performance testing of the equipment include in this Division with the Commissioning Agent.

B. Acceptance Check List

1. An acceptance checklist shall be completed that documents compliance with each item of this Specification.

C. Testing Procedure

1. Upon completion of the installation, the DDC Contractor shall start-up the system and perform all necessary testing and run diagnostic tests to ensure proper operation. The DDC Contractor shall be responsible for generating all software and entering all database information necessary to perform the sequences of control herein specified.

D. Testing Documentation

1. Prior to acceptance testing, DDC Contractor shall create, on an individual system basis, trend logs of input and output points, or have an automatic Point History feature for documentation purposes.

E. Field Points Testing

1. This step shall verify that all of the installed points receive or transmit the correct information prior to loading/activating the system software.

2. ON/OFF commands from the workstation shall be performed in order to verify each binary output point.

3. All binary input points are to be tested using the HAND/OFF/AUTOMATIC selector switch on the associated motor control center or by manually jumpering across the field device contacts.

4. All analog output points providing pneumatic output control shall be tested using a command from the workstation to modulate the output from minimum calibrated signal to maximum calibrated signal.

5. All analog output points shall be tested using a command from the workstation to modulate the output device from minimum calibrated signal to maximum calibrated output.

6. All analog input points are to be tested by comparing the reading obtained through the workstations or portable terminal to the value of an independent testing meter.

F. Noncompliant Items

1. The Contractor shall remove and replace, at its expense, all items that are not in compliance with the Specification requirements.

3.2 EXAMINATION

A. Verify that power supply is available to control units and operator workstation.

B. Verify that pneumatic piping and duct-, pipe-, and equipment-mounted devices are installed before proceeding with installation.

C. Examine existing equipment designated for controls replacement and integration into the new BMS to determine hardware and gateway requirements.

3.3 INSTALLATION

A. Install software in control units and operator workstation(s). Implement all features of programs to specified requirements and as appropriate to sequence of operation.

B. Connect and configure equipment and software to achieve sequence of operation specified.

C. Verify mounting heights in first paragraph below with authorities having jurisdiction to comply with requirements of the Americans with Disabilities Act.

D. Verify location of thermostats, sensors and other exposed control sensors with Drawings and room details before installation. Install devices 60 inches (1530 mm) above the floor.

E. Install averaging elements in ducts and plenums in crossing or zigzag pattern.

F. Install stainless steel cover style thermistors on the following locations:
1. Entrances.
2. Public areas.
3. Where indicated.

G. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.

H. Install labels and nameplates to identify control components according to Division 23 Section "Identification for HVAC Piping and Equipment."

I. Install hydronic instrument wells, valves, and other accessories according to Division 23 Section "Hydronic Piping."

J. Install refrigerant instrument wells, valves, and other accessories according to Manufacturer’s installation instructions.

K. Install duct volume-control dampers according to Division 23 Sections specifying air ducts.

L. Install all new controls and devices for existing HVAC equipment remaining, as required to fully integrate systems into the new Building Management System and achieve the Sequence of Operation indicated in Section 230993.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.

   a. Test and adjust controls and safeties.

2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
3. Test calibration of electronic controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
4. Test each point through its full operating range to verify that safety and operating control set points are as required.
5. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
6. Test each system for compliance with sequence of operation.
7. Test software and hardware interlocks.

C. DDC Verification

1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
2. Check instruments for proper location and accessibility.
3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
4. Check instrument tubing for proper fittings, slope, material, and support.
5. Check installation of air supply for each instrument.

6. Check flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.
7. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
8. Check temperature instruments and material and length of sensing elements.
9. Check control valves. Verify that they are in correct direction.

D. Check DDC system as follows:

1. Verify that DDC controller power supply is from emergency power supply, if applicable.
2. Verify that wires at control panels are tagged with their service designation and approved tagging system.
3. Verify that spare I/O capacity has been provided.
4. Verify that DDC controllers are protected from power supply surges

3.5 COMMISSIONING

A. Commissioning the DDC Control system is a mandatory documented performance requirement of the selected DDC Contractor for all control systems detailed in this Specification and sequence of operations. Commissioning shall include verification of proper installation practices by the DDC Contractor and subcontractors under the DDC Contractor, point verification and calibration, system/sequence of operation verification with respect to specified operation, and network/workstation verification.

B. Acceptance Check List
1. An acceptance checklist shall be completed that documents compliance with each item of this Specification.

C. Testing Procedure
1. Upon completion of the installation, the DDC Contractor shall start-up the system and perform all necessary testing and run diagnostic tests to ensure proper operation. The DDC Contractor shall be responsible for generating all software and entering all database information necessary to perform the sequences of control herein specified.

D. Testing Documentation
1. Prior to acceptance testing, DDC Contractor shall create, on an individual system basis, trend logs of input and output points, or have an automatic Point History feature for documentation purposes.

E. Field Points Testing
1. This step shall verify that all of the installed points receive or transmit the correct information prior to loading/activating the system software.
2. ON/OFF commands from the workstation shall be performed in order to verify each binary output point.
3. All binary input points are to be tested using the HAND/OFF/AUTOMATIC selector switch on the associated motor control center or by manually jumpering across the field device contacts.

4. All analog output points providing pneumatic output control shall be tested using a command from the workstation to modulate the output from minimum calibrated signal to maximum calibrated signal.
5. All analog output points shall be tested using a command from the workstation to modulate the output device from minimum calibrated signal to maximum calibrated output.
6. All analog input points are to be tested by comparing the reading obtained through the workstations or portable terminal to the value of an independent testing meter.

F. Noncompliant Items
1. The Contractor shall remove and replace, at its expense, all items that are not in compliance with the Specification requirements

END OF SECTION 230900

SECTION 230993 - SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

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. This Section includes control sequences for all HVAC systems, subsystems, and equipment.

B. Coordinate required control interface with the manufacturers of packaged equipment.

C. Provide control replacement for existing equipment where indicated.

1.3 DEFINITIONS

A. DDC: Direct digital control.

B. VAV: Variable air volume.

C. BMS: Building Management System.

D. BMCS: Building Management Control System

E. BMS and FMS and BMCS are equivalent regarding definition and scope.

F. ATC: Automatic Temperature Control Contractor conducting work by and under this section.

1.4 CONTROL SEQUENCES

A. General

1. Unless noted otherwise herein, all control functions described in this sequence of operation shall be accomplished by the Building Management Control System (BMCS), and all equipment shall be started, stopped and positioned (if a modulating device) by the BMCS. All hardware necessary to accomplish the control functions shall be provided by the BMCS contractor, unless noted otherwise. The BMCS contractor shall coordinate the quantity of required final drive devices (damper motors, control valves, etc.) and sensors with the mechanical equipment vendor's products.
2. All setpoints described in this sequence of operation shall be fully adjustable throughout the entire range of the sensors being used to measure the variable being controlled. All controlled variables identified in the following sequence of operation shall be maintained at setpoint using proportional-integral control algorithms, in order to ensure that no error exists between the controlled variable and its setpoint at steady-state conditions. Proportional-integral-derivative algorithms shall be used if the process so warrants, at the discretion of the control software programmer.

3. Point Lists provided in the Sequence are a **minimum** and should be used as a guideline. All points listed are required. Additional points will be required to meet the sequence of operations or the specification or the intent of the specification and those points shall be included.
4. Alarms will be set up initially by the ATC contractor, as shown in the point list. The system will be capable of unlimited alarms, but the selected alarms will not be the left for the customer to set. Any alarms that the customer requests to be set up will be done by the contractor at no additional charge.
5. Where equipment is configured for lead/lag operation, the lead unit shall be alternated on a seven (7) day cycle.

B. Hot Water System

1. The hot water system consists of two condensing boilers with factory controllers and dedicated circulators, and the primary building heating loop served by a packaged pump station with factory controller and pump mounted Variable Speed Drives.
2. The hot water system will be enabled automatically through the building automation system (BAS).
3. Where equipment is configured for lead/lag operation, the lead unit shall be alternated on a seven (7) day cycle.
4. The ATC will mount and wire the boiler plant controller provided by the boiler manufacturer.
5. The BMS will integrate via BACnet to the boiler plant controller to provide all information available from the plant controller to the BAS operator workstation.
6. An isolation valve will be furnished by the ATC contractor for each boiler. When a boiler is enabled to run by the boiler plant manager controller or integral boiler controls, the isolation valve will be opened. The valve position will be monitored by the BAS.
7. Multiple condensing water boilers will be supplied. The boilers will sequence based on the boiler plant controller as supplied by the boiler manufacturer.
8. The hot water boiler supply temperature will initially be reset between 100°F degrees and 160°F in linear proportion to the outdoor air temperature as outside air temperature decreases from 50°F to -10°F. The reset schedule shall be optimized by the BMS by making adjustments to the supply water temperature in 1°F increments with 15 minutes between adjustments based on the building heating load as determined by supply and return water temperatures and outside air temperature.
9. Building primary hot water pump station will operate to maintain the building differential pressure through the controller as supplied by the pump station manufacturer. If the differential pressure increases, the speed of the pumps will decrease down to a minimum of 30 percent of design. If the differential pressure decreases the pump speed will increase.
10. Failure of any of the pumps furnished as part of the pump station shall result in an alarm through the BMS. The remaining pumps shall continue to operate to maintain system pressure differential.
11. All Pumps will be provided with Hand-Off-Auto switches at the starter or variable frequency drives. The Building automation system will control the system in the “Auto” mode.
12. An emergency shut off switch will be provided at each egress. If the switch is activated, all combustion equipment will be turned off. These switches will be hard wired to the boilers and water heaters.
13. Via CO gas detector, on CO level increase above set point, the boiler room ventilation fan will be started and intake and relief dampers will open.

POINT LIST:		ALARMS TO BE SET UP BY ATC
AI	Outdoor Air Temperature	
AI	Outdoor Air Humidity	
AI	Boiler #1 HW Supply Temp.	Alarm on +/- 10 deg.
AI	Boiler #2 HW Supply Temp.	Alarm on +/- 10 deg.
AI	Boiler #1 HW Return Temp.	
AI	Boiler #2 HW Return Temp.	
AI	Common HW Supply Temp.	Alarm on +/- 10 deg.
AI	Common HW Return Temp.	
AI	Bldg. Hot water supply pressure	Must Be Separate from Return
AI	Bldg. Hot water return pressure	Must Be Separate from Supply
AI	Hot water pump HWP #1 VFD feedback	
AI	Hot water pump HWP #2 VFD feedback	
AI	Boiler room temperature	
DO	Boiler #1 Enable	
DO	Boiler #2 Enable	
DO	Boiler #1 Isolation Valve Open/Close	
DO	Boiler #2 Isolation Valve Open/Close	
DO	Boiler Pump BP #1 On/Off	
DO	Boiler Pump BP #2 On/Off	
DO	Boiler room exhaust fan On/Off	
DI	Boiler #1 Isolation Valve Open Status	
DI	Boiler #2 Isolation Valve Open Status	
DI	Boiler #1 status	
DI	Boiler #1 Alarm	Alarm on Fail
DI	Boiler #2 status	
DI	Boiler #2 Alarm	Alarm on Fail
DI	Primary HW pump P-1 Status	Alarm on Fail
DI	Primary HW pump P-2 Status	Alarm on Fail
DI	Primary HW pump P-3 Status	Alarm on Fail
DI	Boiler pump BP-1 Status	Alarm on Fail
DI	Boiler pump BP-2 Status	Alarm on Fail
DI	CO gas detection (Provided by ATC)	Alarm on detection
DI	Exhaust fan run status	Alarm on Fail
DI	Emergency Switch Status X (# of Egress)	
AO	BP-1 Speed	
AO	BP-2 Speed	
AO	HWP P-1 Speed	
AO	HWP P-2 Speed	
AO	HWP P-3 Speed	
AO	B-1 hot water setpoint	
AO	B-2 hot water setpoint	

C. Domestic Hot Water

1. The existing domestic hot water system will be enabled/disabled based on a time of day schedule.
2. When the building is unoccupied, the domestic hot water heater will be disabled.
3. The domestic hot water pumps will be monitored for run status.
4. The domestic hot water temperature will be monitored.

POINT LIST:		ALARMS TO BE SET UP BY ATC
AI	Domestic hot water temperature.	Alarm on +/- 10 deg.
DI	Domestic hot water pump run status	Alarm on failure
DI	Combustion Air Damper Position	Alarm on failure
DI	Combustion Fan Run Status	Alarm on failure
DO	Combustion Air Damper Open/Close	
DO	Combustion Air Fan On/Off	
DO	Domestic hot water heater enable/disable	
DO	Domestic hot water pump start/stop	

D. Dedicated Outside Air Dehumidification Units

1. The units shall be indexed for Occupied, Night Setback, Morning Warm Up or Unoccupied mode by the BAS. No Morning cool down mode will be provided. Operating mode shall be indexed based on Occupied/Unoccupied time schedule.
2. The systems will operate in sequence providing the system safeties are satisfied. The fan shall not start until all smoke and fire/smoke dampers serving the unit are proven to be open.
3. Night Set-Back: The heating space temperature set points will be initially set 10 degrees below the Occupied setpoint (adj.). The outdoor air and exhaust air damper will remain closed. The return air damper will be open 100%. The supply fan will cycle on when heating is required and the hot water valve will modulate to maintain a discharge air reset temperature setpoint. The BAS system will monitor the space temperature sensors of all of the associated zones. The system will operate in Night Set-Back mode based on the coldest monitored temperature. The energy recovery wheels will be off.
4. Occupied mode: the supply and exhaust fans shall be enabled, the outdoor air damper will open to a minimum setpoint, the return damper will open inversely to the outdoor air damper and the exhaust damper will open 100%. The energy recovery wheel will be energized.
5. The supply fan shall run continuously during the occupied cycle and be controlled by VFD to run at 70% of design speed when CO2 levels in all zones served by the unit are below setpoint based on inputs from zone CO2 sensors. The supply fan speed will be modulated from 70% to 100% to maintain space CO2 level below setpoint based on input from the zone CO2 sensor recording the greatest CO2 level.
6. The return/exhaust fan speed shall modulate in response to input from space pressure sensors to maintain approximately neutral space pressure.
7. The outdoor air CFM, supply fan speed and exhaust fan speed will be monitored by the BMS.
8. The energy recovery wheel speed will modulate to maintain the mixed air temperature setpoint.
9. If cooling is required, mechanical cooling section will maintain the discharge air set point.
10. If heating is required, the hot water valve will modulate to maintain the discharge air temperature setpoint.
11. A temperature sensor will be provided at the discharge of the heating coils representing the inlet temperature of the supply air side of the secondary energy recovery exchanger.
12. The discharge air dewpoint setpoint will be maintained. A dewpoint transmitter will be provided at the discharge of each unit. Dewpoint setpoint will be 48 degrees initially (adj.)
13. If cooling is required and the outdoor air enthalpy is lower than the exhaust air enthalpy, the primary energy recovery wheel will be stopped.

14. Each energy recovery wheel will be controlled by the BMS through factory provided variable frequency drives.
15. Each energy recovery wheel will be monitored for rotation status.
16. Energy recovery wheel speed shall be modulated when outside air temperature is below 32°F as required to prevent frost from accumulating on the wheel media.
17. If the heating coil discharge air temperature drops below 40° F (adjustable) as measured by a discharge air sensor, the recirculation damper shall be opened and the outside air damper shall be closed, and the exhaust fan shall be de-energized. A trouble alarm shall be indicated through the BMS indicating low discharge air temperature. The unit shall automatically return to normal occupied mode after 30 minutes.
18. A manual reset, low temperature control shall monitor the heating coil discharge air temperature. If the temperature of the discharge air should fall below 37° F (adjustable), the system shall stop the supply and exhaust fans, position the outside air damper to fully closed, the recirculation damper to fully open, and position the hot water coil control valve to fully open. An alarm will then be sent to the BAS operator workstation indicating a shutdown of the system has occurred due to the low limit safety.
19. The duct smoke detectors shall provide a signal to the BAS if products of combustion are present within the system or area served. The BAS will respond to this indication by shutting down the supply and return fans and closing the outside air damper. An alarm will then be sent to the BAS operator workstation indicating a shutdown of the system has occurred due to the duct smoke detectors.
20. Current sensors installed at the supply and exhaust fans shall monitor the supply and return fans status. If the supply or return fan status should differ from the command, an alarm shall be sent to the BAS operator workstation. The fan Variable Frequency Drives will be monitored for fault and signal feedback.
21. A water detector will monitor the condensate pan for high water level. If the condensate level switch detects high water level, an alarm will be generated at the operator workstation.
22. A high static pressure sensor shall monitor the supply duct static pressure. If the static pressure of the supply air duct exceeds the setpoint of the sensor, the BAS shall command both the supply and return fans to stop. An alarm shall then be sent to the BAS operator workstation indicating that a shutdown of the system has occurred due to the duct high static pressure switch. A manual reset will be required in order to restart the system after a high duct static pressure safety shutdown.
23. Upon loss of power the outside air and exhaust air dampers shall close and the hot water valve shall go to the full open position.
24. The following minimum points list shall be provided.

POINT LIST:		TO BE SET UP BY ATC CONTRACTOR
AI	Space CO2 levels for each zone sensor	Alarm on high limit.
AI	Return air dewpoint level	Alarm on high limit.
AI	Outdoor Air CFM	
AI	Supply Fan Speed	
AI	Return/Exhaust Fan Speed	
AI	Return Air Temperature	Alarm on Failure
AI	Return Air Relative Humidity	Alarm on Failure
AI	Energy wheel disch. air temp.	
AI	Mixed Air Temperature	
AI	Hot Water coil discharge air temp.	
AI	Secondary Energy Recovery Device disch. air temp. (Before Chilled Water Coil)	

AI	Secondary Energy Recovery Device disch. air temp. (Before Reheat Coil)	
AI	Secondary Energy Recovery Device Dewpoint (Before Chilled Water Coil)	
AI	Supply Air Dewpoint	Alarm on Failure or +/- setpoint
AI	Supply Air Temperature	Alarm on Failure or +/- setpoint
AI	Exhaust Air Temperature (Leaving Energy Wheel)	
AI	Mechanical Cooling Status	From Unit Controls
AI	Heating Valve position feedback	From Actuator
AI	Outside Air Damper position feedback	From Actuator
AI	Return Air Damper position feedback	From Actuator
AI	Exhaust Air Damper position feedback	From Actuator
DI	Supply Fan Status	Alarm on Fan Start Failure
DI	Return Fan Status	Alarm on Fan Start Failure
DI	Supply Side Filter status	Alarm on high differential pressure
DI	Return/Exhaust Air Filter status	Alarm on high differential pressure
DI	Low Limit Thermostat	Alarm on Low Temperature
DI	Duct pressure high limit	Alarm on high pressure
DI	Supply duct smoke detector	Alarm on smoke
DI	Return duct smoke detector	Alarm on smoke
DI	Compressor Status	For each Compressor
DI	Energy wheel rotation status.	
DI	Condensate Water Detection	Alarm on detection
DO	Supply Fan Start/Stop	
DO	Return Fan Start/Stop	
DO	Energy Wheel Start/Stop	
DO	Energy Wheel by-pass damper open / close	
AO	Supply Fan Speed	
AO	Return/Exhaust Fan Speed	
AO	Outside Air Damper Modulate	Must be Separate from R.A. & E.A.
AO	Return Air Damper Modulate	Must be Separate from R.A. & E.A.
AO	Exhaust Air Damper Modulate	Must be Separate from R.A. & E.A.
AO	Energy Wheel Speed	
AO	Chilled Water Valve	
AO	Hot Water Valve	
AO	Supply Fan Speed VFD	
AO	Return/Exhaust Fan Speed VFD	

E. Packaged Rooftop Air Conditioning Units

1. The units shall be indexed for Occupied, Night Setback, Morning Warm Up or Unoccupied mode by the BAS. No Morning cool down mode will be provided. Operating mode shall be indexed based on Occupied/Unoccupied time schedule.
2. The systems will operate in sequence providing the system safeties are satisfied. The fan shall not start until all smoke and fire/smoke dampers serving the unit are proven to be open.
3. Night Set-Back: The heating space temperature set points will be initially set 10 degrees below the Occupied setpoint (adj.). The outdoor air and exhaust air damper will remain closed. The return air damper will be open 100%. The supply fan will cycle on when heating is required and the hot water valve will modulate to maintain a discharge air reset temperature setpoint. The BAS system will monitor the space temperature sensors of all

of the associated zones. The system will operate in Night Set-Back mode based on the coldest monitored temperature. The energy recovery wheels will be off.

4. Occupied mode: the supply and exhaust fans shall be enabled, the outdoor air damper will open to a minimum sposition, the return damper will open inversely to the outdoor air damper and the exhaust damper will open 100%. The energy recovery wheel will be energized.
5. The supply fan shall run continuously during the occupied cycle and be controlled by VFD to run at 70% of design speed when space temperature setpoint is satisfied and when CO2 levels in all zones served by the unit are below setpoint based on inputs from zone CO2 sensors. The supply fan speed will be modulated from 70% to 100% as space temperature deviates from setpoint between 2°F and 4°F and to maintain space CO2 level below setpoint based on input from the zone CO2 sensor recording the greatest CO2 level.
6. The return/exhaust fan speed shall modulate in response to input from space pressure sensors to maintain approximately neutral space pressure.
7. The outdoor air CFM, supply fan speed and exhaust fan speed will be monitored by the BMS.
8. The energy recovery wheel speed will modulate to maintain the mixed air temperature setpoint.
9. If cooling is required, mechanical cooling section will maintain the space temperature setpoint.
10. If heating is required, the gas burner will fire and modulate to maintain the space temperature setpoint.
11. If cooling is required and the outdoor air enthalpy is lower than the exhaust air enthalpy, the primary energy recovery wheel will be stopped.
12. Each energy recovery wheel will be controlled by the BMS through factory provided variable frequency drives.
13. The energy recovery wheel will be monitored for rotation status.
14. Energy recovery wheel speed shall be modulated when outside air temperature is below 32°F as required to prevent frost from accumulating on the wheel media.
15. A manual reset, low temperature control shall monitor the discharge air temperature. If the temperature of the discharge air should fall below 40° F. (adjustable), the system shall stop the supply and return fans, position the outside air damper to the fully closed position, and position the recirculation damper to the full open position. An alarm will then be sent to the BAS operator workstation indicating a shutdown of the system has occurred due to the low limit safety.
16. The duct smoke detectors shall provide a signal to the BAS if products of combustion are present within the system or area served. The BAS will respond to this indication by shutting down the supply and return fans and closing the outside air damper. An alarm will then be sent to the BAS operator workstation indicating a shutdown of the system has occurred due to the duct smoke detectors.
17. Current sensors installed at the supply and exhaust fans shall monitor the supply and return fans status. If the supply or return fan status should differ from the command, an alarm shall be sent to the BAS operator workstation. The fan Variable Frequency Drives will be monitored for fault and signal feedback.
18. A water detector will monitor the condensate pan for high water level. If the condensate level switch detects high water level, an alarm will be generated at the operator workstation.
19. A high static pressure sensor shall monitor the supply duct static pressure. If the static pressure of the supply air duct exceeds the setpoint of the sensor, the BAS shall command both the supply and return fans to stop. An alarm shall then be sent to the BAS operator

workstation indicating that a shutdown of the system has occurred due to the duct high static pressure switch. A manual reset will be required in order to restart the system after a high duct static pressure safety shutdown.

20. Upon loss of power the outside air and exhaust air dampers shall close and the recirculation air shall go to the full open position.
21. The following minimum points list shall be provided.

POINT LIST:		TO BE SET UP BY ATC CONTRACTOR
AI	Space CO2 level	Alarm on high limit.
AI	Outdoor Air CFM	
AI	Supply Fan Speed	
AI	Return/Exhaust Fan Speed	
AI	Return Air Temperature	Alarm on Failure
AI	Return Air Relative Humidity	Alarm on Failure
AI	Energy wheel disch. air temp.	
AI	Mixed Air Temperature	
AI	Gas burner discharge air temp.	
AI	Supply Air Temperature	Alarm on Failure or +/- setpoint
AI	Exhaust Air Temperature (Leaving Energy Wheel)	
AI	Mechanical Cooling Status	From Unit Controls
DI	Gas Burner Status	From Unit Controls
AI	Gas Valve Position	From Unit Controls
AI	Outside Air Damper position feedback	From Actuator
AI	Return Air Damper position feedback	From Actuator
AI	Exhaust Air Damper position feedback	From Actuator
DI	Supply Fan Status	Alarm on Fan Start Failure
DI	Return Fan Status	Alarm on Fan Start Failure
DI	Supply Side Filter status	Alarm on high differential pressure
DI	Return/Exhaust Air Filter status	Alarm on high differential pressure
DI	Low Limit Thermostat	Alarm on Low Temperature
DI	Duct pressure high limit	Alarm on high pressure
DI	Supply duct smoke detector	Alarm on smoke
DI	Compressor Status	For each Compressor
DI	Energy wheel rotation status.	
DI	Condensate Water Detection	Alarm on detection
DO	Supply Fan Start/Stop	
DO	Return Fan Start/Stop	
DO	Energy Wheel Start/Stop	
DO	Energy Wheel by-pass damper open / close	
AO	Supply Fan Speed	
AO	Return/Exhaust Fan Speed	
AO	Outside Air Damper Modulate	Must be Separate from R.A. & E.A.
AO	Return Air Damper Modulate	Must be Separate from R.A. & E.A.
AO	Exhaust Air Damper Modulate	Must be Separate from R.A. & E.A.
AO	Energy Wheel Speed	
AO	Supply Fan Speed VFD	
AO	Return/Exhaust Fan Speed VFD	

F. Energy Recovery Ventilators

1. The units consist of packaged Energy Recovery Ventilators with supply fan, exhaust fan, enthalpy type energy recovery heat exchanger, hot water coil, control valve, filters, and dampers.

2. The units provide heating and ventilation to the toilet rooms.

3. The units shall be indexed for Occupied, Night Setback, Morning Warm Up or Unoccupied mode by the BAS. Operating mode shall be indexed based on Occupied/Unoccupied time schedule.

4. During occupied periods, the supply and exhaust fans shall be energized and the outside air and exhaust air dampers shall be open. The hot water control valve shall modulate to maintain space temperature based in input from space temperature sensor.

5. During the unoccupied mode, the outside air and exhaust air dampers shall be closed and the recirculation damper shall be open. The supply fan shall cycle and the hot water valve shall modulate as required to main space unoccupied temperature setpoint.

6. During morning warm-up, the outside air and exhaust air dampers shall be closed and the recirculation damper shall be open. The supply fan shall cycle and the hot water valve shall open as required to raise space temperature to the occupied temperature setpoint, at which time the unit shall be indexed to the occupied mode.

7. Upon loss of power the outside air and exhaust air dampers shall close and the hot water valve shall go to the full open position.

8. Heat Recovery Exchanger Frost Control: The Outside Air damper shall cycle to provide frost control in the event that the exhaust air leaving the heat exchanger drops below 40°F (adj).

9. Low Limit: A freeze stat shall be installed with serpentine element on the discharge side of the hot water coil. If the temperature along any segment of the freeze stat element drops below 40°F the supply and exhaust fans shall stop, the outside air and exhaust air dampers shall close and the recirculation damper and hot water control valve shall go to full open. A low limit alarm shall be transmitted though the BMS.

10. Current sensors installed at the supply and exhaust fans shall monitor the supply and return fans status. If the supply or return fan status should differ from the command, an alarm shall be sent to the BAS operator workstation. The fan Variable Frequency Drives will be monitored for fault and signal feedback.

11. The following minimum points list shall be provided:

POINTS LIST		ALARMS TO BE SET UP BY ATC
AI	Space Temperature	Alarm on failure or +/- 4 degrees of setpoint
DI	Supply Fan status	Alarm on failure
DI	Exhaust Fan status	Alarm on failure
DI	Outside Air Damper Position	
DI	Exhaust Air Damper Position	
DI	Recirculation Air Damper Position	
AI	Discharge Air Temperature.	
AI	Exhaust Air Temperature leaving Heat Exchanger	
DO	Fan start/stop	

G. Variable Refrigerant Volume (VRV) System

1. These systems will be provided from the factory with open protocol BACnet controls. The ATC contractor will mount and wire the provided space temperature sensors and provide the interlock wiring for the remote condensing units.

2. All system functions will be monitored and addressed through the BMS. The BMS will monitor system operation and associated space temperature. An alarm will be generated through the BMS if any portion of the system fails to operate per the commanded value, or, in the event that the space temperature rises above the setpoint by 4 degrees.

3. The VRV Fan Coil Units shall be controlled through the factory controller to operate initially at low speed. If the system is unable to maintain space cooling temperature setpoint at low speed, the fan speed shall be increased in steps to the minimum speed required to maintain space temperature.

4. The VRV systems will maintain space heating temperature setpoint through the heat pump function. If space temperature drops to 2°F below space heating setpoint, the hot water control valve serving space Finned Tube Radiation or Hot Water Duct Coils shall be opened by the BMS to maintain space temperature.

5. The following minimum points list shall be provided for each zone:

POINTS LIST		ALARMS TO BE SET UP BY ATC
AI	Space Temperature	Alarm on failure or +/- 4 degrees of setpoint
DI	Fan Coil Unit Status	On/Off - Alarm on failure
AI	Fan Coil Unit Speed	
DI	System Status	Heating or Cooling
AO	Hot Water Control Valve Position	
DO	Fan start/stop	

H. Cabinet Unit Heaters

1. Occupied mode: Fan will cycle to maintain occupied space temperature setpoint based on input from wall mounted space temperature sensor.
2. Unoccupied mode: Fan will cycle to maintain unoccupied space temperature setpoint based on input from wall mounted space temperature sensor.
3. A pipe mounted electric aqua-stat will enable fan control when hot water is sensed.

POINTS LIST		ALARMS TO BE SET UP BY ATC
AI	Space Temperature	Alarm on failure or +/- 4 degrees of setpoint
DI	Fan status	Alarm on failure
DO	Fan start/stop	

I. Unit Heaters

1. Control valve shall open on call for heating from space temperature controller based on input from wall mounted space temperature sensor.
2. A pipe mounted electric aqua-stat will start unit fan when hot water is sensed.
3. Control valve shall close when space temperature is satisfied and fan will be de-energized.

POINTS LIST		ALARMS TO BE SET UP BY ATC
AI	Space Temperature	Alarm on failure or +/- 4 degrees of setpoint
DI	Control Valve Position	
DI	Fan status	Alarm on failure
DO	Fan start/stop	

J. Split A/C Systems

1. These systems will be provided from the factory with controls. The ATC contractor will mount and wire the provided space temperature sensors and provide the interlock wiring for the remote condensing units.
2. The BAS will monitor the associated space temperature. If the space temperature rises above the setpoint by 4 degrees, an alarm will be generated at the OWS.

POINT LIST:		ALARMS TO BE SET UP BY ATC
AI	Space Temperature	Alarm on +/- 4 degrees of setpoint

K. Science Prep Room Exhaust Fans

1. Lab exhaust fans will run continuously twenty-four (24) hours per day, three hundred sixty-five (365) days per year but will be under the control of the BMS system.
2. Fans will be monitored for run status. If a fan fails to operate, an alarm will be generated at the OWS.

POINT LIST:		ALARMS TO BE SET UP BY ATC
DO	Fan Start/Stop	
DI	Fan Run Status	Alarm on fan run failure

L. Existing Exhaust Fans – Typical

1. Fans shall be energized during the occupied period and de-energized during unoccupied periods except where under local manual control such as the kitchen exhaust fans, or where controlled with other HVAC equipment for space pressure relief.
2. Fan will be monitored for “run status” and alarmed at the OWS on fan failure.

POINT LIST:		ALARMS TO BE SET UP BY ATC
DO	Fan Start/Stop	
DI	fan status	Alarm on fan run failure.

M. Toilet – Exhaust Fans – Typical

1. Fan will be started and stopped by occupancy sensor located in space.
2. Fan will be monitored for “run status” and alarmed at the OWS on fan failure.

POINT LIST:		ALARMS TO BE SET UP BY ATC
DI	fan status	Alarm on fan run failure.

N. Boiler Room

1. The new damper installed at existing louver shall open when space temperature rises above 80°F and close when temperature drops below 60°F.

2. The outside air damper and relief air damper shall be open when the supply fan is energized.

3. The unit heater shall be enabled by aquastat when space temperature drops below heating setpoint.

POINT LIST:		ALARMS TO BE SET UP BY ATC
AI	Boiler Room Space Temperature	Alarm on + 4 degrees of setpoint
DO	Damper Position	
DI	Outside Air Damper Position	Alarm on failure
DO	Control Valve Position	Alarm on failure
DI	Unit Heater Fan Status	Alarm on failure

O. Existing Heating and Ventilating Units Serving Classrooms

1. Occupied Mode: The supply fan shall start, the outside air damper shall modulate open to the minimum position (5 percent) and the gas burner shall modulate or be controlled through available stages as required to maintain space heating temperature setpoint.

   The CO2 controls shall modulate outside air damper between 5 and 50 percent as required to maintain CO2 concentrations below setpoint (800 ppm adjustable).

   Economizer Controls shall modulate outside air damper between position determined by CO2 controls and the full open position as required to maintain space cooling temperature setpoint. Relief air damper shall modulate to maintain approximately neutral space pressure.

   Recirculation damper shall be controlled in opposition to outside air damper.

   Discharge air temperature shall be limited to 95°F (adjustable) based on input from discharge air temperature sensor.

   Where equipped with Bypass VAV system, the discharge air shall be maintained as required for space heating and cooling, the zone dampers shall modulate to maintain space temperature and the bypass damper(s) shall modulate to maintain duct supply duct pressure setpoint

2. Unoccupied mode: The outside air damper and relief air damper shall be closed, recirculation damper shall be open. The supply fan shall cycle and the gas burner shall fire to maintain space unoccupied temperature setpoint.

3. Low Limit: A manual reset, low temperature control shall monitor the discharge air temperature. If the temperature of the discharge air should fall below 40° F. (adjustable), the system shall stop the supply and return fans, position the outside air damper to the fully closed position, and position the recirculation damper to the full open position. An alarm will then be sent to the BAS operator workstation indicating a shutdown of the system has occurred due to the low limit safety.

4. Points List:

		ALARMS TO BE SET UP BY ATC
AI	Space Temperature	Alarm on failure or +/- 4 degrees of setpoint
AI	Discharge Air Temperature	Alarm on failure or +/- 4 degrees of setpoint
DI	Supply Fan status	Alarm on failure
AO	Outside Air Damper Position	

AO	Relief Air Damper Position	
AO	Recirculation Air Damper Position	
AO	Gas Burner Position	
AI	Space CO2 level	
DI	Low Limit	Alarm on discharge temperature below 40 degrees
DO	Fan start/stop	

P. Existing Heating and Ventilating Units Serving Kitchen

1. Occupied Mode: The supply fan shall start, the outside air damper shall modulate open to the minimum position (5 percent) and the gas burner shall modulate or be controlled through available stages as required to maintain space heating temperature setpoint.

   Economizer Controls shall modulate outside air damper between minimum position and the full open position as required to maintain space cooling temperature setpoint.

   Recirculation damper shall be controlled in opposition to outside air damper.

   Discharge air temperature shall be limited to 95°F (adjustable) based on input from discharge air temperature sensor.

   A current sensor shall monitor supply fan status and an alarm shall be sent if the status does not match the commanded value.

2. Unoccupied mode: The outside air damper and relief air damper shall be closed, recirculation damper shall be open. The supply fan shall cycle and the gas burner shall fire to maintain space unoccupied temperature setpoint.

3. Low Limit: A manual reset, low temperature control shall monitor the discharge air temperature. If the temperature of the discharge air should fall below 40° F. (adjustable), the system shall stop the supply and return fans, position the outside air damper to the fully closed position, and position the recirculation damper to the full open position. An alarm will then be sent to the BAS operator workstation indicating a shutdown of the system has occurred due to the low limit safety.

4. Points List:

		ALARMS TO BE SET UP BY ATC
AI	Space Temperature	Alarm on failure or +/- 4 degrees of setpoint
AI	Discharge Air Temperature	Alarm on failure or +/- 4 degrees of setpoint
DI	Supply Fan status	Alarm on failure
AO	Outside Air Damper Position	
AO	Relief Air Damper Position	
AO	Recirculation Air Damper Position	
AO	Gas Burner Position	
DO	Fan start/stop	

Q. Existing Heating and Ventilating Units Serving Cafeteria

1. Occupied Mode: The supply fan shall start, the outside air damper shall modulate open to the minimum position (5 percent) and the gas burner shall modulate or be controlled through available stages as required to maintain space heating temperature setpoint.

   The CO2 controls shall modulate outside air damper between 5 and 50 percent as required to maintain CO2 concentrations below setpoint (800 ppm adjustable).

Economizer Controls shall modulate outside air damper between position determined by CO2 controls and the full open position as required to maintain space cooling temperature setpoint. Exhaust fan shall be energized and exhaust damper shall modulate to maintain approximately neutral space pressure.

Recirculation damper shall be controlled in opposition to outside air damper.

Discharge air temperature shall be limited to 95°F (adjustable) based on input from discharge air temperature sensor.

2. Unoccupied mode: The outside air damper and exhaust air damper shall be closed, recirculation damper shall be open. Exhaust fans shall be de-energized. The supply fan shall cycle and the gas burner shall fire to maintain space unoccupied temperature setpoint.

3. Low Limit: A manual reset, low temperature control shall monitor the discharge air temperature. If the temperature of the discharge air should fall below 40° F. (adjustable), the system shall stop the supply and return fans, position the outside air damper to the fully closed position, and position the recirculation damper to the full open position. An alarm will then be sent to the BAS operator workstation indicating a shutdown of the system has occurred due to the low limit safety.

4. Points List:

Points List:	ALARMS TO BE SET UP BY ATC
AI Space Temperature	Alarm on failure or +/- 4 degrees of setpoint
AI Discharge Air Temperature	Alarm on failure or +/- 4 degrees of setpoint
DI Supply Fan status	Alarm on failure
AO Outside Air Damper Position	
AO Relief Air Damper Position	
AO Recirculation Air Damper Position	
AO Gas Burner Position	
AI Space CO2 level	
DI Low Limit	Alarm on discharge temperature below 40 degrees
DO Fan start/stop	

R. Equipment Monitoring

1. Some equipment not provided or controlled by this division will require interface wiring and alarm monitoring. The following point list is a **minimum** requirement. Others may be required and shown on the drawings.
2. Alarms will be generated at the OWS and set-up by control contractor.

S. Drain Pans

1. BMS will monitor and alarm drain pan and or auxiliary pan water detection through float switch. For water detection condition, head end shall be alarmed and mechanical cooling shall be shut down.

POINT LIST:	ALARMS TO BE SET UP BY ATC
DI Float Switch	Alarm on Water Detection
DO Fan on/off	
DI Cooling Status	

END OF SECTION 230993

SECTION 233113 - METAL DUCTS

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. Single-wall rectangular ducts and fittings.
2. Single-wall round ducts and fittings.
3. Double-wall round ducts and fittings.
4. Sheet metal materials.
5. Duct liner.
6. Duct Lagging Material.
7. Sealants and gaskets.
8. Hangers and supports.
9. Seismic-restraint devices.

B. Related Sections:

1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Duct hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."

B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

1.4 SUBMITTALS

A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.

3. Seismic-restraint devices.

B. HPBS Submittals:

1. Product Data for Section 16a-38k-5(d): For adhesives and sealants, documentation including printed statement of VOC content and chemical components.
2. Laboratory Test Reports for Section 16a-38k-5(d): For adhesives and sealants, documentation indicating that product complies 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:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.
13. Preparation for selecting hangers and supports and seismic restraints.

D. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.

E. Welding certificates.

F. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code - Steel," for hangers and supports. AWS D1.2, "Structural Welding Code -

Aluminum," for aluminum supports. AWS D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D1.2, "Structural Welding Code - Aluminum," for aluminum supports.
3. AWS D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:

a. Lindab Inc.
b. McGill AirFlow LLC.
c. SEMCO Incorporated.
d. Sheet Metal Connectors, Inc.
e. Spiral Manufacturing Co., Inc.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 DOUBLE-WALL SPIRAL ROUND DUCTS AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:

1. Lindab Inc.
2. McGill AirFlow LLC.
3. SEMCO Incorporated.
4. Sheet Metal Connectors, Inc.

B. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.

1. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
2. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
3. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals,"

and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Inner Duct: Minimum 0.028-inch solid sheet steel.

D. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071 and NFPA 90A; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Maximum Thermal Conductivity: 0.13 Btu x in./h x sq. ft. x deg F at 75 deg F (24 deg C) mean temperature.
2. Insulation Thickness: 2 inches.
3. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
4. Coat insulation with antimicrobial coating.
5. Cover insulation with polyester film complying with UL 181, Class 1.

2.4 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653.

1. Galvanized Coating Designation: G90.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Carbon-Steel Sheets: Comply with ASTM A 1008, with oiled, matte finish for exposed ducts.

D. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

E. Reinforcement Shapes and Plates: ASTM A 36, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

F. Tie Rods: Galvanized steel, ¼-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.5 DUCT LINER

A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071 Type 1, ASHRAE 62, SMACNA Application Standards for Duct Liners, NFPA 90A, and NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
   a. Johns Manville – Permacote Linacoustic RC-HC
   b. Similar product offered by the following manufacturers:
      1) CertainTeed Corporation.
      2) Knauf Insulation.
      3) Owens Corning.

2. Type I, Flexible.
3. Maximum Conductance: 0.23 Btu/h · sq. ft. · deg F at 75 deg F mean temperature.
4. Minimum NRC: 0.75
5. Antimicrobial Erosion-Resistant Coating: Applied to the surface of the liner, a cleanable surface that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested in accordance with ASTM C1338, ASTM G21 and ASTM G22, and be registered by the EPA for use in HVAC systems.
6. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 tested according to ASTM E 84
7. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.

   a. Use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Insulation Pins and Washers:

1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated with integral 1½-inch galvanized carbon-steel washer.
2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick aluminum; with beveled edge sized as required to hold insulation securely in place but not less than 1½ inches in diameter.

C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-19, "Flexible Duct Liner Installation."

1. Adhere a single layer of indicated thickness of duct liner with at least ninety percent (90%) adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
3. Butt transverse joints without gaps, and coat joint with adhesive.
4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
6. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.

7. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:

   a. Fan discharges.
   b. Intervals of lined duct preceding unlined duct.

8. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.6 DUCT LAGGING MATERIAL

A. General: Flexible barrier material for wrapping ducts to lower break-out noise from turbulent air.

B. Nominal Density: 1 lb/sq. ft.

C. Thickness: 0.10 inch

D. The barrier is barium loaded high mass, limp vinyl bonded to a reinforced aluminum foil facing one side, Under Industries model DL-10-LAG or equivalent.

E. Sound Transmission Loss: dB

Hz	125	250	500	1000	2000	4000	STC
dB	15	19	21	29	33	37	27

2.7 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of twenty-five (25) and a maximum smoke-developed index of fifty (50) when tested according to UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: 4 inches.
3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum sixty-five percent (65%).
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Solvent-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Base: Synthetic rubber resin.
3. Solvent: Toluene and heptane.
4. Solids Content: Minimum sixty percent (60%).
5. Shore A Hardness: Minimum 60.
6. Water resistant.
7. Mold and mildew resistant.

E. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.

F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

G. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.8 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

H. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

2.9 SEISMIC-RESTRAINT DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:

1. Cooper B-Line, Inc.; a division of Cooper Industries.
2. Ductmate Industries, Inc.
3. Hilti Corp.
4. Kinetics Noise Control.
5. Loos & Co.; Cableware Division.
6. Mason Industries.
7. TOLCO; a brand of NIBCO INC.
8. Unistrut Corporation; Tyco International, Ltd.

B. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.

C. Restraint Cables ASTM A 492, stainless-steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.

D. Hanger Rod Stiffener: Reinforcing steel angle clamped to hanger rod.

E. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 DUCT APPLICATIONS

A. All ductwork shall be galvanized steel except as follows:

1. Shower/Locker Area: Aluminum.

3.2 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install duct liner as indicated in Part 3.13 “Duct Liner Schedule”.

C. Where duct liner is required, indicated duct dimensions are the clear inside lined duct dimensions.

D. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

E. Install all products in accordance with manufacturer’s installation instructions.

F. Install round ducts in maximum practical lengths.

G. Install ducts with fewest possible joints.

H. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

I. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

J. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

K. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

L. Route ducts to avoid passing through electrical equipment rooms and enclosures.

M. Where ducts pass through non-fire-rated interior partitions and exterior walls and are not exposed to view, seal gaps in accordance with Section 078413 Penetration Firestopping.

N. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four (4) sides by at least 1½ inches. Seal gaps in accordance with Section 078413 Penetration Firestopping.

O. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers. Seal gaps in accordance with Section 078413 Penetration Firestopping.

P. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."

Q. Install acoustic lagging material where indicated on plans.

3.3 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.4 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.6 SEISMIC-RESTRAINT-DEVICE INSTALLATION

A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes.

B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install cable restraints on ducts that are suspended with vibration isolators.

E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction.

F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.

G. Drilling for and Setting Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid pre-stressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Set anchors to manufacturer's recommended torque, using a torque wrench.
5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.7 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.8 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one (1) coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09 painting Sections.

3.9 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:

1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.

2. Test the following systems:

   a. Supply Ducts and Plenums designed to operate at a pressure exceeding 3 inch wg.
   b. Return Ducts and Plenums designed to operate at a pressure exceeding 3 inch wg.
   c. Exhaust Ducts and Plenums designed to operate at a pressure exceeding 3 inch wg. Outside Air Ducts and Plenums designed to operate at a pressure exceeding 3 inch wg.
   d. All Ductwork located outdoors.

3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
4. Test for leaks before applying external insulation.
5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
6. Give seven days' advance notice for testing.

C. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present.
2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."

a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.10 DUCT CLEANING

A. Clean new duct systems before testing, adjusting, and balancing.

B. Use service openings for entry and inspection.

1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Division 23 Section "Air Duct Accessories" for access panels and doors.
2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

D. Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.

3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.11 START UP

A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.12 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

B. Supply Ducts:

1. Ducts Connected to Fan Coil Units:

a. Pressure Class: Positive 1-inch wg.

2. Ducts Connected to Constant-Volume Air-Handling Units:

a. Pressure Class: Positive 3-inch wg.

C. Return Ducts:

1. Ducts Connected to Fan Coil Units:

a. Pressure Class: Positive or negative 1-inch wg.

2. Ducts Connected to Air-Handling Units Pressure Class: Positive or negative 3-inch wg.

D. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:

a. Pressure Class: Negative 2-inch wg.

E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:

1. Ducts Connected to Air-Handling Units:

a. Pressure Class: Positive or negative 3-inch wg.

F. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel.
2. Aluminum Ducts: Aluminum.

G. Duct Liner: Refer to Duct Liner Schedule below.

H. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."

a. Velocity 1000 fpm or Lower:

1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
2) Mitered Type RE 4 without vanes.

b. Velocity 1000 to 1500 fpm:

1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two (2) vanes.
3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."

c. Velocity 1500 fpm or Higher:

1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two (2) vanes.
3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."

2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."

a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."

3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."

a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.

1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three (3) segments for 90-degree elbow.
2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four (4) segments for 90-degree elbow.
3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five (5) segments for 90-degree elbow.
4) Radius-to Diameter Ratio: 1.5.

b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
c. Round Elbows, 14 Inches and Larger in Diameter: Welded.

I. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."

a. Rectangular Main to Rectangular Branch: 45-degree entry.
b. Rectangular Main to Round Branch: Spin in.

2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees." Saddle taps are permitted in existing duct.

a. Velocity 1000 fpm or Lower: 90-degree tap.
b. Velocity 1000 to 1500 fpm: Conical tap.
c. Velocity 1500 fpm or Higher: 45-degree lateral.

3.13 DUCT LINER SCHEDULE - All duct liner shall be 2 inch think unless indicated otherwise.

1. Band Room:
a. FCU-2-2A & B supply ducts: 5 feet lined length.

2. Computer Room #107:
a. FCU-6-1A & B supply ducts: 5 feet lined length.

3. Computer Room #161:
a. FCU-6-1A & B supply ducts: 5 feet lined length.

4. General Music Room #147:
a. FCU-1-2A & B supply ducts: 5 feet lined length.

5. Gym Stage:
a. FCU-2-3A & B supply ducts: 5 feet lined length.

6. Learning Center:

a. FCU-8-1 & 2 supply ducts: 10 feet lined length.

7. Science CLAB 106:
   a. FCU-2-3A & B supply ducts: 5 feet lined length.

8. Science CLAB 109:
   a. FCU-6-2A & B supply ducts: 5 feet lined length.

9. Chorus/Strings 153:
   a. FCU-1-1A & B supply ducts: 5 feet lined length.

10. DOAS-1:
    a. Supply Duct: 30 feet lined from unit discharge.
    b. Return Duct: 20 feet lined from unit inlet.

11. DOAS-2:
    a. Supply Duct: 10 feet lined from unit discharge.
    b. Return Duct: 15 feet lined from unit inlet.

12. DOAS-3:
    a. Supply Duct: 10 feet lined from unit discharge.
    b. Return Duct: 10 feet lined from unit inlet.

13. DOAS-4:
    a. Supply Duct: 10 feet lined from unit discharge.
    b. Return Duct: 10 feet lined from unit inlet.

14. DOAS-5:
    a. Supply Duct: 15 feet lined from duct silencer.
    b. Return Duct: 25 feet lined from unit inlet.

15. RTU-1:
    a. Supply Duct: 10 feet lined from duct silencer.
    b. Return Duct: None.

16. Art Room – Existing Rooftop H&V Unit:
    a. Supply Duct: 10 feet lined from unit discharge.
    b. Return Duct: 10 feet lined from unit inlet.

END OF SECTION 233113

SECTION 233300 - AIR DUCT ACCESSORIES

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. Manual volume dampers.
2. Control dampers.
3. Fire dampers.
4. Ceiling radiation dampers.
5. Smoke dampers.
6. Combination fire and smoke dampers.
7. Flange connectors.
8. Duct silencers.
9. Turning vanes.
10. Remote damper operators.
11. Duct-mounted access doors.
12. Flexible connectors.
13. Flexible ducts.
14. Duct accessory hardware.
15. Sound Lagging Insulation

B. Related Sections:

1. Division 28 Section "Digital, Addressable Fire Alarm System" for duct-mounted fire and smoke detectors.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.

B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:

a. Special fittings.
b. Manual volume damper installations.
c. Control damper installations.
d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
e. Wiring Diagrams: For power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.5 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.

1.6 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with AMCA 500-D testing for damper rating..

PART 2 - PRODUCTS

2.1 MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653.

1. Galvanized Coating Designation: G90.
2. Exposed-Surface Finish: Mill phosphatized.

C. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, one (1) side bright finish for exposed ducts.

D. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.

E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

F. Tie Rods: Galvanized steel, ¼-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:

   a. Air Balance, Inc.
   b. METALAIRE, Inc.
   c. Penn Ventilation Company, Inc.
   d. Ruskin Company

2. Standard leakage rating, with linkage outside airstream.
3. Suitable for horizontal or vertical applications.
4. Frames:

   a. Hat-shaped, galvanized steel channels, 0.064-inch minimum thickness.
   b. Mitered and welded corners.
   c. Flanges for attaching to walls and flangeless frames for installing in ducts.

5. Blades:

   a. Multiple or single blade.
   b. Parallel- or opposed-blade design.
   c. Stiffen damper blades for stability.
   d. Galvanized steel, 0.064 inch thick.

6. Blade Axles: Galvanized steel.
7. Bearings:

   a. Molded synthetic.
   b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

8. Tie Bars and Brackets: Galvanized steel.

B. Low-Leakage, Steel, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:

   a. Air Balance, Inc.
   b. Metal-Aire, Inc.
   c. Penn Ventilation Company, Inc.
   d. Ruskin Company

2. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.

3. Suitable for horizontal or vertical applications.
4. Frames:

    a. Angle shaped.
    b. Galvanized steel channels, 0.064 inch thick.
    c. Mitered and welded corners.
    d. Flanges for attaching to walls and flangeless frames for installing in ducts.

5. Blades:

    a. Multiple or single blade.
    b. Parallel- or opposed-blade design.
    c. Stiffen damper blades for stability.
    d. Galvanized, roll-formed steel, 0.064 inch thick.

6. Blade Axles: Galvanized steel.
7. Bearings:

    a. Molded synthetic.
    b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

8. Blade Seals: Neoprene.
9. Jamb Seals: Cambered stainless steel
10. Tie Bars and Brackets: Galvanized steel.
11. Accessories:

    a. Include locking device to hold single-blade dampers in a fixed position without vibration.

C. Jackshaft:

1. Size: 1-inch diameter.
2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

D. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch-thick zinc-plated steel, and a ¾-inch hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

2.3 CONTROL DAMPERS (provided by controls contractor)

A. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:

1. Air Balance, Inc.
2. METALAIRE, Inc.
3. Penn Ventilation Company, Inc.
4. Ruskin Company

B. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.

C. Frames:

1. Angle shaped.
2. Galvanized-steel channels, 0.064 inch thick.
3. Mitered and welded corners.

D. Blades:

1. Multiple blade with maximum blade width of 8 inches.
2. Parallel- and opposed blade design.
3. Galvanized steel.
4. 0.064 inch thick.
5. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.

E. Blade Axles: ½-inch-diameter; galvanized steel blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.

1. Operating Temperature Range: From minus 40 to plus 200 deg F (minus 40 to plus 93 deg C).

F. Bearings:

1. Stainless-steel sleeve.
2. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
3. Thrust bearings at each end of every blade.

2.4 FIRE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:

1. Air Balance, Inc.
2. METALAIRE, Inc.
3. Penn Ventilation Company, Inc.
4. Ruskin Company

B. Type: Static; rated and labeled according to UL 555 by an NRTL.

C. Fire Rating: 1½ hours.

D. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch-thick galvanized steel; with mitered and interlocking corners.

E. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.

1. Minimum Thickness: 0.052 or 0.138 inch thick, as indicated, and of length to suit application.
2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.

F. Mounting Orientation: Vertical or horizontal as indicated.

G. Blades: Roll-formed, interlocking, 0.034-inch-thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch-thick, galvanized-steel blade connectors.

H. Horizontal Dampers: Include blade lock and stainless-steel closure spring.

I. Heat-Responsive Device: Replaceable, 165 deg F (74 deg C) rated, fusible links.

2.5 SMOKE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:

1. Air Balance, Inc.
2. METALAIRE, Inc.
3. Penn Ventilation Company, Inc.
4. Ruskin Company

B. General Requirements: Label according to UL 555S by an NRTL.

C. Smoke Detector: Integral, factory wired for single-point connection.

D. Frame: Hat-shaped, 0.094-inch-thick, galvanized sheet steel, with welded corners and mounting flange.

E. Blades: Roll-formed, horizontal, interlocking 0.034-inch-galvanized sheet steel.

F. Rated pressure and velocity to exceed design airflow conditions.

G. Mounting Sleeve: Factory-installed, 0.05-inch-thick, galvanized sheet steel; length to suit wall or ceiling application with factory-furnished silicone calking.

H. Damper Motors: Two-position action.

I. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 and 28 Sections.

3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F (minus 40 deg C).
6. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
7. Electrical Connection: 115 V, single phase, 60 Hz.

J. Accessories:

1. Auxiliary switches for signaling.
2. Test and reset switches, damper mounted.

2.6 COMBINATION FIRE AND SMOKE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:

1. Air Balance, Inc.
2. METALAIRE, Inc.
3. Penn Ventilation Company, Inc.
4. Ruskin Company

B. Type: Static; rated and labeled according to UL 555 and UL 555S by an NRTL.

C. Fire Rating: 1½ hours.

D. Frame: Multiple-blade type; fabricated with roll-formed, 0.034-inch-thick galvanized steel; with mitered and interlocking corners.

E. Heat-Responsive Device: Electric resettable link and switch package, factory installed, rated.

F. Smoke Detector: Integral, factory wired for single-point connection.

G. Blades: Roll-formed, horizontal, interlocking, 0.034-inch-thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch-thick, galvanized-steel blade connectors.

H. Mounting Sleeve: Factory-installed, 0.052-inch-thick, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone calking.

I. Damper Motors: two-position action.

J. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.
3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F (minus 40 deg C).
6. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
7. Electrical Connection: 115 V, single phase, 60 Hz.

K. Accessories:

1. Auxiliary switches for position indication.

2.7 FLANGE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:

1. Ductmate Industries, Inc.
2. Nexus PDQ; Division of Shilco Holdings Inc.
3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Description: Roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.

D. Gage and Shape: Match connecting ductwork.

2.8 TURNING VANES

A. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. METALAIRE, Inc.

4. SEMCO Incorporated.
5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

D. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."

E. Vane Construction: Single wall for ducts up to 12 inches wide and double wall for larger dimensions.

2.9 DUCT-MOUNTED ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:

1. Air Balance, Inc.
2. METALAIRE, Inc.
3. Penn Ventilation Company, Inc.
4. Ruskin Company
5. Ductmate Industries. Inc.

B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-10, "Duct Access Doors and Panels," and 2-11, "Access Panels - Round Duct."

1. Door:

a. Double wall, rectangular.
b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
c. Vision panel.
d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
e. Fabricate doors airtight and suitable for duct pressure class.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Number of Hinges and Locks:

a. Access Doors Less Than 12 Inches Square: No hinges and two (2) sash locks.
b. Access Doors up to 18 Inches Square: Two (2) hinges and two (2) sash locks.
c. Access Doors up to 24 by 48 Inches: Three (3) hinges and two (2) compression latches with outside and inside handles.

d. Access Doors Larger Than 24 by 48 Inches: Four (4) hinges and two (2) compression latches with outside and inside handles.

C. Pressure Relief Access Door:

1. Door and Frame Material: Galvanized sheet steel.
2. Door: Double wall with insulation fill with metal thickness applicable for duct pressure class.
3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.
4. Doors close when pressures are within set-point range.
5. Hinge: Continuous piano.
6. Latches: Cam.
7. Seal: Neoprene or foam rubber.
8. Insulation Fill: 1-inch-thick, fibrous-glass or polystyrene-foam board.

2.10 DUCT ACCESS PANEL ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:

1. Ductmate Industries, Inc.
2. Flame Gard, Inc.
3. 3M.

B. Labeled according to UL 1978 by an NRTL.

C. Panel and Frame: Minimum thickness 0.0528-inch carbon steel.

D. Fasteners: Carbon steel. Panel fasteners shall not penetrate duct wall.

E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F (1093 deg C).

F. Minimum Pressure Rating: 10-inch wg, positive or negative.

2.11 INSULATED FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. Ventfabrics, Inc.
4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3½ inches wide attached to 2 strips of 2¾-inch-wide, 0.028-inch-thick, galvanized sheet steel or 0.032-inch-thick aluminum sheets. Provide metal compatible with connected ducts.

E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd.
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).

F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.

1. Minimum Weight: 24 oz./sq. yd.
2. Minimum Tensile Strength: 500 lbf/inch in the warp and 440 lbf/inch in the filling.
3. Service Temperature: Minus 50 to plus 250 deg F (Minus 45 to plus 121 deg C).

G. High-Temperature System, Flexible Connectors: Glass fabric coated with silicone rubber.

1. Minimum Weight: 16 oz./sq. yd.
2. Tensile Strength: 285 lbf/inch in the warp and 185 lbf/inch in the filling.
3. Service Temperature: Minus 67 to plus 500 deg F (Minus 55 to plus 260 deg C).

H. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.

1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
2. Outdoor Spring Diameter: Not less than eighty percent (80%) of the compressed height of the spring at rated load.
3. Minimum Additional Travel: Fifty percent (50%) of the required deflection at rated load.
4. Lateral Stiffness: More than eighty percent (80%) of rated vertical stiffness.
5. Overload Capacity: Support two hundred percent (200%) of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Coil Spring: Factory set and field adjustable for a maximum of ¼-inch movement at start and stop.

2.12 FLEXIBLE DUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:

1. Flexmaster U.S.A., Inc.
2. McGill AirFlow LLC.
3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Insulated, Flexible Duct: UL 181, Class 1, multiple layers of aluminum laminate with polyethylene liner, supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.

1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 20 to plus 210 deg F (Minus 29 to plus 99 deg C).
4. Installed Insulation value: R-5

C. Flexible Duct Connectors:

1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.

2.13 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

2.14 SOUND LAGGING INSULATION

A. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:

1. Sound Seal.

B. Flexible, 2 lb/square foot reinforced foil-faced mass loaded vinyl noise barrier, 0.23 inch thick.

C. Foil-faced lag tape.

2.15 HEAT AND SMOKE VENTS

A. Hatch-Type Heat and Smoke Vents: Manufacturer's standard, with single-walled insulated curbs, welded or mechanically fastened and sealed corner joints, integral condensation gutter, and cap flashing. Fabricate with insulated double-walled lid and continuous weathertight perimeter lid gaskets, and equip with automatic self-lifting mechanisms and UL-listed fusible links rated at 165 deg F.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product by Bilco indicated on Drawings or comparable product by one of the following:

a. Babcock-Davis.
b. Bristolite Skylights.
c. Dur-Red Products.
d. Hi Pro International, Inc.

e. J. L. Industries, Inc.
f. Milcor Inc.; Commercial Products Group of Hart & Cooley, Inc.
g. Naturalite Skylight Systems; Vistawall Group (The).
h. Nystrom.
i. O'Keeffe's Inc.
j. Pate Company (The).
k. Western Canwell.

2. Type and Size: Double-leaf lid, 72 by 96 inches.
3. Loads: Minimum 40-lbf/sq. ft. external live load and 30-lbf/sq. ft. internal uplift load.

   a. When release is actuated, lid shall open against 10-lbf/sq. ft. snow or wind load and lock in position.
   b. Hatch-Lid Glazing: Minimum 40-lbf/sq. ft. external live load and 20-lbf/sq. ft. internal uplift load.

4. Heat and Smoke Vent Standard: Provide units that have been tested and listed to comply with UL 793.
5. Curb, Framing, and Lid Material: Zinc-coated (galvanized) steel sheet, 0.079 inch thick.

   a. Finish: Baked enamel or powder coat.
   b. Color: As selected by Architect from manufacturer's full range.

6. Curb, Framing, and Lid Material: Aluminum sheet, 0.090 inch thick.

   a. Finish: Baked enamel or powder coat.

   b. Color: As selected by Architect from manufacturer's full range.

7. Curb, Framing, and Lid Material: Stainless-steel sheet, 0.078 inch thick.

   a. Finish: Manufacturer's standard.

8. Construction:

   a. Insulation: Glass-fiber board.
   b. Hatch Lid: Opaque, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
   c. Hatch Lid: Glazed, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
   d. Exterior Curb Liner: Manufacturer's standard, of same material and finish as metal curb.
   e. Fabricate curbs to minimum height of 12 inches unless otherwise indicated.
   f. Sloping Roofs: Where slope or roof deck exceeds 1:48, fabricate curb with perimeter curb height that is constant. Equip hatch with water diverter or cricket on side that obstructs water flow.
   g. Security Grille: Provide where indicated.

9. Hatch-Lid Glazing: Double acrylic glazing of thickness capable of resisting indicated loads; white, translucent.

10. Hardware: Manufacturer's standard, corrosion resistant or hot-dip galvanized; with hinges, hold-open devices, and independent manual-release devices for inside and outside operation of lids.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install control dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

1. Install steel volume dampers in steel ducts.
2. Install aluminum volume dampers in aluminum ducts.

E. Set dampers to fully open position before testing, adjusting, and balancing.

F. Install test holes at fan inlets and outlets and elsewhere as indicated.

G. Install fire and smoke dampers according to UL listing.

H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. On both sides of duct coils.
2. Upstream from duct filters.
3. At outdoor-air intakes and mixed-air plenums.
4. At drain pans and seals.
5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
7. At each change in direction and at maximum 50-foot spacing.
8. Upstream and downstream from turning vanes.
9. Upstream or downstream from duct silencers.
10. Control devices requiring inspection.

11. Elsewhere as indicated.

I. Install access doors with swing against duct static pressure.

J. Access Door Sizes:

1. One-Hand or Inspection Access: 8 by 5 inches.
2. Two-Hand Access: 12 by 6 inches.
3. Head and Hand Access: 18 by 10 inches.
4. Head and Shoulders Access: 21 by 14 inches.
5. Body Access: 25 by 14 inches.
6. Body plus Ladder Access: 25 by 17 inches.

K. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

L. Install flexible connectors to connect ducts to equipment.

M. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

N. Connect terminal units to supply ducts with maximum 60-inch lengths of flexible duct. Do not use flexible ducts to change directions.

O. Connect diffusers or light troffer boots to ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.

P. Provide 6 feet minimum 12 inch dia. Lined flexible duct to each supply diffuser. Connect flexible ducts to metal ducts with liquid adhesive plus stainless steel duct clamp.

Q. Flexible ducts to diffusers shall have a minimum of one 90 degree bend between main duct and diffuser with a minimum radius of bend not less than 3 feet.

R. Install duct test holes where required for testing and balancing purposes.

S. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of ¼-inch movement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.
5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 233300

SECTION 235216 - CONDENSING BOILERS

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. This Section includes packaged, factory-fabricated and -assembled, gas-fired, condensing boilers, trim, and accessories for generating hot water.

1.3 SUBMITTALS

A. Product Data: Include performance data, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: For boilers, boiler trim, and accessories. Include plans, elevations, sections, details, and attachments to other work.

1. Design calculations and vibration isolation base details, signed and sealed by a qualified professional engineer.
   a. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails and equipment mounting frames.

2. Wiring Diagrams: Power, signal, and control wiring.

C. Manufacturer Seismic Qualification Certification: Submit certification that boiler, accessories, and components will withstand seismic forces defined in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Source quality-control test reports.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For boilers to include in emergency, operation, and maintenance manuals.

G. Warranty: Special warranty specified in this Section.

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.

B. ASME Compliance: Fabricate and label boilers to comply with ASME Boiler and Pressure Vessel Code.

C. ASHRAE/IESNA 90.1 Compliance: Boilers shall have minimum efficiency according to "Gas and Oil Fired Boilers - Minimum Efficiency Requirements."

D. DOE Compliance: Minimum efficiency shall comply with 10 CFR 430, Subpart B, Appendix N, "Uniform Test Method for Measuring the Energy Consumption of Furnaces and Boilers."

E. UL Compliance: Test boilers for compliance with UL 795, "Commercial-Industrial Gas Heating Equipment." Boilers shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.

1.5 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of boilers that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Condensing Boilers:

a. Pressure Vessel/Heat Exchanger failure due to condensate corrosion, thermal stress, mechanical defects or workmanship: Non-prorated for seven (7) years from date of Substantial Completion.
b. Heat exchanger: twenty (20) years from date of Substantial Completion against thermal shock.
c. Burner: five (5) years from date of Substantial Completion.
d. All other components: 18-month from date of Substantial Completion against failure due to defective materials or workmanship.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hydrotherm
2. Burnham - Apex
3. Cleaver Brooks
4. Aerco
5. Viessman

2.2 CONDENSING BOILERS

A. Description: As scheduled on drawings, factory-fabricated, -assembled and -tested cast iron heat exchanger or water-tube condensing boiler with heat exchanger sealed pressure-tight, built on a steel base; including insulated jacket; flue-gas vent; combustion-air intake connections; water supply, return and condensate drain connections; and controls. Water heating service only.

B. Fabricate base and attachment to pressure vessel with reinforcement strong enough to resist boiler movement during a seismic event when boiler base is anchored to building structure.

C. The boilers shall be design certified by CSA International and shall meet the requirements of ANSI Z21.13. The heating boiler shall be vented as a Category IV condensing appliance.

D. Boiler Characteristics and Capacities: See Schedule on drawings.

E. Water-Tube Boiler Components:

1. Heat Exchanger: Cast iron or finned-copper primary and stainless-steel secondary heat exchangers.
2. Combustion Chamber: Stainless steel, sealed.
3. Burner: Natural gas, forced draft drawing from gas premixing valve.
4. Blower: Centrifugal fan to operate during each burner firing sequence and to pre-purge and post-purge the combustion chamber. See schedule
5. Gas Train: Combination gas valve with manual shutoff and pressure regulator. Include 100 percent safety shutoff with electronic flame supervision.
6. Ignition: Silicone carbide hot-surface ignition that includes flame safety supervision and 100 percent main-valve shutoff.
7. Integral Circulator: Cast-iron body and stainless-steel impeller sized for minimum flow required in heat exchanger.
8. Casing:

a. Jacket: Stainless steel.
b. Control Compartment Enclosures: NEMA 250, Type 1A.
c. Finish: Textured epoxy.
d. Insulation: Minimum 2-inch- thick fiberglass insulation surrounding the heat exchanger.
e. Combustion-Air Connections: Inlet and vent duct collars.

9. Mounting base to secure boiler to concrete base.

2.3 HOT-WATER BOILER TRIM

A. Include devices sized to comply with ANSI B31.9, "Building Services Piping".

B. Aquastat Controllers: Operating, firing rate, and high limit.

C. Safety Relief Valve: ASME rated. 30 psig (210 kPa).

D. Altitude and Temperature Gage: Minimum 3½-inch- (89-mm-) diameter, combination water-pressure and -temperature gage. Gages shall have operating-pressure and -temperature ranges so normal operating range is at approximately 50 percent of full range.

E. Boiler Air Vent: Automatic.

F. Drain Valve: Minimum NPS ¾ (DN 20) hose-end gate valve.

2.4 CONTROLS AND FIRING MODE

A. Controls shall include an electronic proportional integrated combination limit/operator control accurate to 1 deg. F having a 4-20 mA output signal suitable for control of a variable frequency motor drive. The control shall also provide readouts of boiler target, differential and inlet/outlet temperatures as well as accumulated run time. An on/off switch and full diagnostic light package shall be provided. The complete control package shall be mounted on the front panel with hinged door for easy access to all control modules. A flow switch shall be provided loose.

B. The burner shall operate as fully modulating down to 35% of the heating load.

C. Light off shall be at no more than 50% input to assure rumble free soft start.

D. Each boiler shall incorporate dual over-temperature protection with manual reset and an electric low water cut-off with manual reset, both in accordance with ASME Section IV and CSD-1.

2.5 GAS TRAIN AND IGNITION MODE

A. The gas train shall consist of a gas valve with pressure regulating electro-hydraulic actuator to provide slow opening, fast closing, safety shutoff and air/gas ratio control. A factory pre-set combination metering valve and orifice shall be provided for setting combustion parameters.

B. The ignition module shall employ a proved igniter with 3 tries for ignition and with 1 hour reset. Trial for ignition shall be 10 seconds with 15 seconds between retrials.

2.6 BOILER OPERATING CONTROLS

A. Refer to Section 23 09 00.

B. Building Management System Interface: Factory-installed hardware and software to enable building management system to monitor and control hot-water set point and display boiler status and alarms.

1. A communication interface with building automation system shall enable building automation system operator to remotely control and monitor the boiler from an operator workstation. Control features available, and monitoring points displayed, locally at boiler control panel shall be available through building automation system.

2.7 SOURCE QUALITY CONTROL

A. Test and inspect factory-assembled boilers, before shipping, according to ASME Boiler and Pressure Vessel Code: Section I, for high-pressure boilers and Section IV, for low-pressure boilers.

2.8 ELECTRICAL POWER

A. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in Division 26 Sections.

B. Single-Point Field Power Connection: Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to boiler.
1. House in NEMA 250, Type 1enclosure.
2. Wiring shall be numbered and color-coded to match wiring diagram.
3. Install factory wiring outside of an enclosure in a metal raceway.
4. Field power interface shall be to nonfused disconnect switch.
5. Provide branch power circuit to each motor and to controls with a disconnect switch or circuit breaker.
6. Provide each motor with overcurrent protection.

2.9 VENTING

A. Category IV venting: Refer to Section 23 51 00.

B. Combustion-Air Intake: Complete system, galvanized duct terminating through louver with screen.

2.10 SOURCE QUALITY CONTROL

A. Burner and Hydrostatic Test: Factory adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions, and carbon monoxide in flue gas and to achieve combustion efficiency; perform hydrostatic test.

B. Test and inspect factory-assembled boilers, before shipping, according to ASME Boiler and Pressure Vessel Code.

C. Allow Owner access to source quality-control testing of boilers. Notify Architect 14 days in advance of testing.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before boiler installation, examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, and piping and electrical connections to verify actual locations, sizes, and other conditions affecting boiler performance, maintenance, and operations.

1. Final boiler locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.

B. Examine mechanical spaces for suitable conditions where boilers will be installed.

C. Examine entry to boiler room for clearances required to move boiler into final location.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 BOILER INSTALLATION

A. Boiler shall be shipped broken down for field assembly or disassembled and reassembled in field as required to move boiler into boiler room.

B. Install boilers level on concrete base. Concrete base is specified in Division 23 Section "Common Work Results for HVAC," and concrete materials and installation requirements are specified in Division 03.

C. Vibration Isolation: Elastomeric isolation pads with a minimum static deflection of 0.25 inch (6.35 mm). Vibration isolation devices and installation requirements are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

D. Install gas-fired boilers according to NFPA 54.

E. Assemble and install boiler trim.

F. Install electrical devices furnished with boiler but not specified to be factory mounted.

G. Install control wiring to field-mounted electrical devices.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to boiler to allow service and maintenance.

C. Install piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection. Provide an isolation valve if required.

D. Connect piping to boilers, except safety relief valve connections, with flexible connectors of materials suitable for service. Flexible connectors and their installation are specified in Division 23 Section "Common Work Results for HVAC,"

E. Connect gas piping to boiler gas-train inlet with union. Piping shall be at least full size of gas train connection. Provide a reducer if required.

F. Connect hot-water piping to supply- and return-boiler tappings with shutoff valve and union or flange at each connection.

G. Install piping from safety relief valves to nearest floor drain.

H. Install piping from safety valves to drip-pan elbow and to nearest floor drain.

I. Boiler Venting:

1. Install combustion-air intake.
2. Connect full size to boiler connections. Comply with requirements in Division 23 Section "Breechings, Chimneys, and Stacks." And manufacturer’s requirement.

J. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

K. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Perform installation and startup checks according to manufacturer's written instructions.
2. Leak Test: Hydrostatic test. Repair leaks and retest until no leaks exist.
3. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.

4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

    a. Burner Test: Adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions, and carbon monoxide in flue gas and to achieve combustion efficiency.
    b. Check and adjust initial operating set points and high- and low-limit safety set points of fuel supply, water level and water temperature.
    c. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Remove and replace malfunctioning units and retest as specified above.

D. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to four(4) visits to Project during other than normal occupancy hours for this purpose.

E. Performance Tests:

1. Engage a factory-authorized service representative to inspect component assemblies and equipment installations, including connections, and to conduct performance testing.
2. Boilers shall comply with performance requirements indicated, as determined by field performance tests. Adjust, modify, or replace equipment to comply.
3. Perform field performance tests to determine capacity and efficiency of boilers.

    a. Test for full capacity.
    b. Test for boiler efficiency at low fire 20, 40, 60, 80, 100, 80, 60, 40, and 20 percent of full capacity. Determine efficiency at each test point.

4. Repeat tests until results comply with requirements indicated.
5. Provide analysis equipment required to determine performance.
6. Provide temporary equipment and system modifications necessary to dissipate the heat produced during tests if building systems are not adequate.
7. Notify Architect in advance of test dates.
8. Document test results in a report and submit to Architect.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain boilers Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 235216

SECTION 237416 - PACKAGED ROOFTOP AIR-CONDITIONING UNITS

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 packaged, small-capacity, rooftop air-conditioning units (RTUs) with the following components and accessories:

1. Casings.
2. Fans.
3. Motors.
4. Refrigerant circuit components.
5. Air filtration.
6. Gas furnaces.
7. Dampers.
8. Electrical power connections.
9. Controls.
10. Accessories.
11. Roof curbs.

1.3 DEFINITIONS

A. DDC: Direct digital controls.

B. ECM: Electronically commutated motor.

C. MERV: Minimum efficiency reporting value.

D. Outdoor-Air Refrigerant Coil: Refrigerant coil in the outdoor-air stream to reject heat during cooling operations and to absorb heat during heating operations. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.

E. RTU: Rooftop unit. As used in this Section, this abbreviation means packaged, small-capacity, rooftop air-conditioning units. This abbreviation is used regardless of whether the unit is mounted on the roof or on a concrete base on ground.

F. Supply-Air Fan: The fan providing supply air to conditioned space. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

G. Supply-Air Refrigerant Coil: Refrigerant coil in the supply-air stream to absorb heat (provide cooling) during cooling operations and to reject heat (provide heating) during heating operations. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

1.4 ACTION SUBMITTALS

A. Product Data: For each RTU.

1. Include manufacturer's technical data.
2. Include rated capacities, dimensions, required clearances, characteristics, and furnished specialties and accessories.

B. Shop Drawings:

1. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Include diagrams for power, signal, and control wiring.

C. Delegated-Design Submittal: For RTU supports 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. Include design calculations for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
2. Detail mounting, securing, and flashing of roof curb to roof structure. Indicate coordinating requirements with roof membrane system.
3. Wind and Seismic Restraint Details: Detail fabrication and attachment of wind and seismic restraints and snubbers. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Structural members to which RTUs will be attached.
2. Roof openings.
3. Roof curbs and flashing.

B. Seismic Qualification Certificates: For RTUs, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

4. Restraint of internal components, including fans, coils, and refrigeration components.

C. Product Certificates: Submit certification that specified equipment will withstand wind forces identified in "Performance Requirements" Article and in Section 230548 "Vibration and Seismic Controls for HVAC."

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculations.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of wind force and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Field quality-control reports.

E. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For RTUs to include in emergency, operation, and maintenance manuals.

1.7 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. Fan Belts: Two set(s) for each belt-driven fan.
2. Filters: Two set(s) of filters for each unit.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of RTUs that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Gas Furnace Heat Exchangers: Manufacturer's standard, but not less than five years from date of Substantial Completion.
2. Warranty Period for Solid-State Ignition Modules: Manufacturer's standard, but not less than three years from date of Substantial Completion.
3. Warranty Period for Control Boards: Manufacturer's standard, but not less than three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 DESCRIPTION

A. AHRI Compliance:

1. Comply with AHRI 210/240 for testing and rating energy efficiencies for RTUs.
2. Comply with AHRI 340/360 for testing and rating energy efficiencies for RTUs.
3. Comply with AHRI 270 for testing and rating sound performance for RTUs.
4. Comply with AHRI 1060 for testing and rating performance for air-to-air exchanger.

B. AMCA Compliance:

1. Comply with AMCA 11 and bear the AMCA-Certified Ratings Seal for air and sound performance according to AMCA 211 and AMCA 311.
2. Damper leakage tested according to AMCA 500-D.
3. Operating Limits: Classify according to AMCA 99.

C. ASHRAE Compliance:

1. Comply with ASHRAE 15 for refrigeration system safety.
2. Comply with ASHRAE 33 for methods of testing cooling and heating coils.
3. Comply with applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

D. ASHRAE/IES Compliance: Comply with applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

E. NFPA Compliance: Comply with NFPA 90A or NFPA 90B.

F. UL Compliance: Comply with UL 1995.

G. 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.

2.2 MANUFACTURERS

A. Daikin.

B. Trane

C. York

D. Carrier

2.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design mounting and restraints for RTUs, including comprehensive engineering analysis.

1. Design RTU supports to comply with wind and seismic performance requirements.

B. Wind-Restraint Performance:

1. Minimum 10 lb/sq. ft. multiplied by the maximum area of the mechanical component projected on a vertical plane that is normal to the wind direction, and 45 degrees either side of normal.

C. Seismic Performance: RTUs, accessories, and components shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

2.4 The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will be fully operational after the seismic event". CAPACITIES AND CHARACTERISTICS

A. Exterior Casing Thickness: 0.079 inch thick.

B. Supply-Air Fan:

1. Fan Type: Belt driven, double width, backward inclined, centrifugal.
2. Fan Type: Double width, forward curved, centrifugal.
3. Enclosure Type: Open, dripproof or Totally enclosed, fan cooled

C. Gas Heating Section:

1. Airflow: See schedule
2. Gas Control Valve: Modulating.
3. Minimum AFUE: See schedule.
4. Minimum Thermal Efficiency: See schedule.
5. Minimum Combustion Efficiency: See schedule.

D. Dampers:

1. Outdoor-Air Damper: Linked damper blades, for zero to 100 percent outdoor air.
2. Outdoor- and Return-Air Mixing Dampers: Parallel-blade galvanized-steel dampers mechanically fastened to cadmium plated for galvanized-steel operating rod in reinforced cabinet. Connect operating rods with common linkage and interconnect so dampers operate simultaneously.
3. Relief-Air Damper: Gravity actuated or motorized, as required by ASHRAE/IES 90.1.

E. Outdoor-Air Filters:

1. One-wide filter racks.
2. Thickness: 2 inches.
3. Filter Type: Glass fiber with minimum 80 percent arrestance, and MERV 8.

F. RTU Electrical Characteristics for Single-Point Connection:

1. Voltage: See schedule
2. Phase: See schedule
3. Hertz: 60.
4. Full-Load Amperes: See schedule
5. Minimum Circuit Ampacity: See schedule
6. Maximum Overcurrent Protection: See schedule

2.5 CASINGS

A. General Fabrication Requirements for Casings: Formed and reinforced double-wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.

B. Double-Wall Construction: Fill space between walls with 2-inch foam insulation and seal moisture tight for R-13 performance.

C. Exterior Casing Material: Galvanized steel with factory-painted finish, with pitched roof panels and knockouts with grommet seals for electrical and piping connections and lifting lugs.

1. Corrosion Protection: 500 hours' salt spray test according to ASTM B 117.

D. Inner Casing Fabrication Requirements:

1. Inside Casing: G-90-coated galvanized steel, 0.028 inch thick**.**

E. Casing Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.

1. Materials: ASTM C 1071, Type I.
2. Liner materials shall have airstream surface coated with erosion- and temperature-resistant coating or faced with a plain or coated fibrous mat or fabric.
3. Liner Adhesive: Comply with ASTM C 916, Type I.

F. Plastic Condensate Drain Pans: Fabricated using rigid heavy plastic polymer, a minimum of 2 inches deep, and complying with ASHRAE 62.1 for design and construction of drain pans.

G. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

2.6 FANS

A. Supply-Air Fans: Aluminum or painted-steel wheels, and galvanized- or painted-steel fan scrolls.

1. Direct-Driven Supply-Air Fans: Motor shall be resiliently mounted in the fan inlet.
2. Belt-Driven Supply-Air Fans: Motors shall be installed on an adjustable fan base resiliently mounted in the casing.

2.7 MOTORS

A. Comply with NEMA MG 1, Design B, medium induction motor, unless otherwise indicated.

B. Comply with IEEE 841 for severe-duty motors.

C. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

D. Duty: Continuous duty at ambient temperature of 104 deg F and at altitude of 3300 feet above sea level.

E. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

F. Efficiency: Energy efficient, as defined in NEMA MG 1.

G. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements.

H. Multispeed Motors: Variable torque.

1. For motors with 2:1 speed ratio, consequent pole, single winding.
2. For motors with other than 2:1 speed ratio, separate winding for each speed.

I. Multispeed Motors: Separate winding for each speed.

J. Rotor: Random-wound, squirrel cage.

K. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

L. Temperature Rise: Match insulation rating.

M. Insulation: Class F

N. Code Letter Designation:

1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
2. Motors Smaller Than 15 HP: Manufacturer's standard starting characteristic.

O. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

P. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

Q. Motors Used with Variable-Frequency Controllers:

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short-time rise pulses produced by pulse-width-modulated inverters.
2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
5. Service Factor: 1.15
6. Motor Bearings:
7. Unusual Service Conditions:
8. Efficiency: Premium efficient.
9. NEMA Design:
10. Service Factor:

2.8 COILS

A. Supply-Air Refrigerant Coil:

1. Copper-plate fin and seamless internally grooved copper tube in steel casing with equalizing-type vertical distributor.
2. Polymer strip shall prevent all copper coils from contacting steel coil frame or condensate pan.
3. Coil Split: Interlaced.
4. Coated.

2.9 REFRIGERANT CIRCUIT COMPONENTS

A. Compressor: Hermetic, variable-speed scroll, mounted on vibration isolators; with internal overcurrent and high-temperature protection, internal pressure relief, and crankcase heater.

B. Refrigeration Specialties:

1. Refrigerant: R-410A.
2. Expansion valve with replaceable thermostatic element.
3. Refrigerant filter/dryer.
4. Manual-reset high-pressure safety switch.
5. Automatic-reset low-pressure safety switch.
6. Minimum off-time relay.
7. Automatic-reset compressor motor thermal overload.
8. Brass service valves installed in compressor suction and liquid lines.
9. Low-ambient kit high-pressure sensor.
10. Hot-gas reheat solenoid valve modulating with a replaceable magnetic coil.
11. Hot-gas bypass solenoid valve with a replaceable magnetic coil.
12. Four-way reversing valve with a replaceable magnetic coil, thermostatic expansion valves with bypass check valves, and a suction line accumulator.

2.10 AIR FILTRATION

A. Comply with NFPA 90A.

B. Filter Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lift out from access plenum.

C. Factory-fabricated, viscous-coated, pleated.

D. Thickness: 2 inches (50 mm).

E. Minimum Merv 10: Refer to equipment schedule on drawings, according to ASHRAE 52.2.

F. Media: Fibrous material formed into deep-V-shaped pleats with antimicrobial agent and held by self-supporting wire grid.

G. Galvanized steel with metal grid on outlet side, steel rod grid on inlet side, hinged, and with pull and retaining handles.

2.11 GAS HEATING SECTION

A. Description: Factory assembled, piped, and wired; complying with ANSI Z21.47/CSA 2.3 and NFPA 54.

1. CSA Approval: Designed and certified by and bearing label of CSA.

B. Burners: Stainless steel.

1. Fuel: Natural gas.
2. Ignition: Electronically controlled electric spark or hot-surface igniter with flame sensor.

C. Heat-Exchanger and Drain Pan: Stainless steel.

D. Venting: Gravity vented with vertical extension.

E. Gas Valve Train: Single-body, regulated, redundant, 24-V ac gas valve assembly containing pilot solenoid valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff.

2.12 DAMPERS

A. Leakage Rate: Comply with ASHRAE/IES 90.1.

B. Damper Motor: Modulating with adjustable minimum position.

2.13 ELECTRICAL POWER CONNECTIONS

A. RTU shall have a single connection of power to unit with unit-mounted disconnect switch accessible from outside unit and control-circuit transformer with built-in overcurrent protection.

2.14 CONTROLS

A. Units shall include a microprocessor controller, fully programmed, wired and tested at the factory:
   1. Controls shall be BACnet compatible and shall interface with new Tridium-Niagra Building Management System being installed as work of this contract. Coordinate requirements with BMS contractor.
   2. Provide all controls, sensors, devices, wiring and programming as required to achieve the Sequence of Operation in Section 230993.
   3. LCD user interface panel for changing setpoints and monitoring unit operation.

B. Provide BACnet controller and sensors to monitor and address the following:
   1. Space humidity
   2. OA / Supply air Inlet temperature
   3. OA Temp after the wheel
   4. Mixed air temperature
   5. After cooling coil temp
   6. After heating section temperature.
   7. Supply discharge temperature
   8. Exhaust after wheel temp
   9 Compressor status (each compressor)
   10. RA/ Exhaust Inlet temp
   11. OA/ Supply Filter pressure
   12. RA/ Exhaust Filter pressure
   13. Supply Fan amps
   14. Exhaust Fan Amps
   15. Wheel rotation monitor
   16. Hot water control valve position
   17. OA damper position
   18. Exhaust damper position
   16. Space Temperature
   17. Hot gas reheat status

C. Modulating Wheel Frost Control

   1. Energy wheel shall be supplied with factory programmed VFD for frost control. Outdoor air temperature sensor and pressure switch across energy wheel shall be provided by unit manufacturer to engage frost control. Wheel shall modulate during frost control to eliminate frost.

E. Refrigerant-Cooling-Coils Controls:

   1. Factory-mounted sensor in unit discharge with sensor adjustment located in control panel to control remote condensing unit to maintain temperature or to integral refrigeration circuit.

F. Hot-Gas Reheat-Coil Operation:

   1. Occupied Periods: Humidistat opens hot-gas valve to provide hot-gas reheat, and cycles the compressor.
   2. Unoccupied Periods: Reheat not required.

G. Gas Furnace Operation:

1. Occupied Periods: Modulate burner to maintain discharge temperature.
2. Unoccupied Periods: Cycle burner to maintain setback temperature.

H. Fixed Minimum Outdoor-Air Damper Operation:

1. Occupied Periods: Open to scheduled CFM position.
2. Unoccupied Periods: Close the outdoor-air damper.

I. Economizer Outdoor-Air Damper Operation:

1. Morning building outdoor-air flush cycles.
2. Occupied Periods: Open to 25 percent fixed minimum intake, and maximum 100 percent of the fan capacity. Controller shall permit air-side economizer operation when outdoor air is less than 60 deg F. Use outdoor-air enthalpy to adjust mixing dampers. Start relief-air fan with end switch on outdoor-air damper. During economizer cycle operation, lock out cooling.
3. Unoccupied Periods: Close outdoor-air damper and open return-air damper.
4. Outdoor-Airflow Monitor: Accuracy maximum plus or minus 5 percent within 15 and 100 percent of total outdoor air. Monitor microprocessor shall adjust for temperature, and output shall range from 4 to 20 mA**.**

J. Carbon Dioxide Sensor Operation:

1. Occupied Periods: Reset minimum outdoor-air ratio down to minimum 10 percent to maintain maximum 800-ppm concentration.
2. Unoccupied Periods: Close outdoor-air damper and open return-air damper.

K. Terminal-Unit Relays:

1. Provide heating- and cooling-mode changeover relays compatible with terminal control system required in Section 233600 "Air Terminal Units" and Section 230923 "Direct Digital Control (DDC) System for HVAC."

L. Interface Requirements for HVAC Instrumentation and Control System:

1. Interface relay for scheduled operation.
2. Interface relay to provide indication of fault at the central workstation and diagnostic code storage.
3. Provide BACnet compatible interface for central HVAC control workstation for the following:

    1. Adjusting set points.
    2. Monitoring supply fan start, stop, and operation.
    3. Inquiring data to include outdoor-air damper position**,** supply- and room-air temperature.
    4. Monitoring occupied and unoccupied operations.
    5. Monitoring constant and variable motor loads.
    6. Monitoring variable-frequency drive operation.
    7. Monitoring cooling load.
    8. Monitoring economizer cycles.
    9. Monitoring air-distribution static pressure and ventilation air volume.

2.14 ACCESSORIES

A. Electric heater with integral thermostat maintains minimum 50 deg F temperature in gas burner compartment.

B. Duplex, 115-V, ground-fault-interrupter outlet with 15-A overcurrent protection. Include transformer if required. Outlet shall be energized even if the unit main disconnect is open**.**

C. Low-ambient kit using variable-speed condenser fans for operation down to 35 deg F.

D. Filter differential pressure switch with sensor tubing on either side of filter. Set for final filter pressure loss.

E. Remote potentiometer to adjust minimum economizer damper position.

F. Return-air bypass damper.

G. Factory- or field-installed, demand-controlled ventilation.

H. Safeties:

1. Smoke detection. Coordinate with Electrical Drawings for fire alarm requirements.
2. Condensate overflow switch.
3. Phase-loss reversal protection.
4. High and low pressure control.
5. Gas furnace airflow-proving switch.

I. Coil guards of painted, galvanized-steel wire.

J. Hail guards of galvanized steel, painted to match casing.

K. Concentric diffuser with white louvers and polished aluminum return grilles, insulated diffuser box with mounting flanges, and interior transition.

L. Door switches to disable heating or reset set point when open.

M. Outdoor-air intake weather hood with moisture eliminator.

N. Oil separator.

2.15 ROOF CURBS

A. Roof curbs with vibration isolators and wind or seismic restraints are specified in Section 230548 "Vibration and Seismic Controls for HVAC."

B. Materials: Galvanized steel with corrosion-protection coating, watertight gaskets, and factory-installed wood nailer; complying with NRCA standards.

1. Curb Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.

    1. Materials: ASTM C 1071, Type I or II.
    2. Thickness: 1-1/2 inches.

2. Application: Factory applied with adhesive and mechanical fasteners to the internal surface of curb.

    1. Liner Adhesive: Comply with ASTM C 916, Type I.
    2. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.
    3. Liner materials applied in this location shall have airstream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric depending on service air velocity.
    4. Liner Adhesive: Comply with ASTM C 916, Type I.

C. Curb Dimensions: Height of 18 inches.

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 RTUs.

B. Examine roughing-in for RTUs to verify actual locations of piping and duct connections before equipment installation.

C. Examine roofs for suitable conditions where RTUs will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Roof Curb: Install on roof structure or concrete base, level and secure, according to NRCA's "NRCA Roofing Manual: Membrane Roof Systems." Install RTUs on curbs and coordinate roof penetrations and flashing with roof construction specified in Section 077200 "Roof Accessories." Secure RTUs to upper curb rail, and secure curb base to roof framing or concrete base with anchor bolts.

B. Unit Support: Install unit level on structural curbs. Coordinate wall penetrations and flashing with wall construction. Secure RTUs to structural support with anchor bolts.

C. Equipment Mounting:
    1. Comply with requirements for vibration isolation and seismic-control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

3.3 CONNECTIONS

A. Comply with duct installation requirements specified in other HVAC Sections. Drawings indicate general arrangement of ducts. The following are specific connection requirements:

    1. Install ducts to termination at top of roof curb.

2. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.
3. Connect supply ducts to RTUs with flexible duct connectors specified in Section 233300 "Air Duct Accessories."
4. Install return-air duct continuously through roof structure.

B. Install condensate trap and drain, minimum connection size. Discharge to splash block.

C. Where installing piping adjacent to RTUs, allow space for service and maintenance.

1. Gas Piping: Comply with applicable requirements in Section 231123 "Facility Natural-Gas Piping." Connect gas piping to burner, full size of gas train inlet, and connect with union and shutoff valve with sufficient clearance for burner removal and service. Contractor to verify gas pressure requirements with available gas pressure.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections with the assistance of a factory-authorized service representative.

C. Tests and Inspections:

1. After installing RTUs and after electrical circuitry has been energized, test units for compliance with requirements.
2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. RTU will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Inspect for visible damage to unit casing.
3. Inspect for visible damage to furnace combustion chamber.
4. Inspect for visible damage to compressor, coils, and fans.
5. Inspect internal insulation.
6. Verify that labels are clearly visible.
7. Verify that clearances have been provided for servicing.
8. Verify that controls are connected and operable.
9. Verify that filters are installed.
10. Clean condenser coil and inspect for construction debris.
11. Clean furnace flue and inspect for construction debris.

12. Connect and purge gas line.
13. Remove packing from vibration isolators.
14. Inspect operation of barometric relief dampers.
15. Verify lubrication on fan and motor bearings.
16. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
17. Adjust fan belts to proper alignment and tension.
18. Start unit according to manufacturer's written instructions.

    1. Start refrigeration system.
    2. Do not operate below recommended low-ambient temperature.
    3. Complete startup sheets and attach copy with Contractor's startup report.

19. Inspect and record performance of interlocks and protective devices; verify sequences.
20. Operate unit for an initial period as recommended or required by manufacturer.
21. Perform the following operations for both minimum and maximum firing. Adjust burner for peak efficiency:

    1. Measure gas pressure on manifold.
    2. Inspect operation of power vents.
    3. Measure combustion-air temperature at inlet to combustion chamber.
    4. Measure flue-gas temperature at furnace discharge.
    5. Perform flue-gas analysis. Measure and record flue-gas carbon dioxide and oxygen concentration.
    6. Measure supply-air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.

22. Calibrate thermostats.
23. Adjust and inspect high-temperature limits.
24. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
25. Start refrigeration system and measure and record the following when ambient is a minimum of 15 deg F above return-air temperature:

    1. Coil leaving-air, dry- and wet-bulb temperatures.
    2. Coil entering-air, dry- and wet-bulb temperatures.
    3. Outdoor-air, dry-bulb temperature.
    4. Outdoor-air-coil, discharge-air, dry-bulb temperature.

26. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
27. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.

    1. Supply-air volume.
    2. Return-air volume.
    3. Relief-air volume.
    4. Outdoor-air intake volume.

28. Simulate maximum cooling demand and inspect the following:

    1. Compressor refrigerant suction and hot-gas pressures.

2. Short circuiting of air through condenser coil or from condenser fans to outdoor-air intake.

29. Verify operation of remote panel including pilot-light operation and failure modes. Inspect the following:

    1. High-temperature limit on gas-fired heat exchanger.
    2. Low-temperature safety operation.
    3. Filter high-pressure differential alarm.
    4. Economizer to minimum outdoor-air changeover.
    5. Relief-air fan operation.
    6. Smoke and firestat alarms.

30. After startup and performance testing and prior to Substantial Completion, replace existing filters with new filters.

3.6 CLEANING AND ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

B. After completing system installation and testing, adjusting, and balancing RTU and air-distribution systems, clean filter housings and install new filters.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain RTUs.

END OF SECTION 237416.11

SECTION 237433 - DEDICATED OUTDOOR-AIR UNITS

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. A. Section includes factory-packaged units capable of supplying up to 100 percent outdoor air and providing cooling, dehumidification and heating.

1.3 PERFORMANCE REQUIREMENTS

A. General Fabrication Requirements: Comply with requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Start-up."

B. Delegated Design: Engage a qualified professional engineer, as defined in Division 01 Section "Quality Requirements," to design vibration isolation, seismic restraints and wind restraints.

C. Seismic Performance: Units shall withstand the effects of earthquake motions determined according to ASCE/SEI 7. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

D. Wind-Restraint Performance:

1. Basic Wind Speed: Refer to Division 5.
2. Building Classification Category: Refer to to Division 5.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include rated capacities, operating characteristics, and furnished specialties and accessories.

B. High Performance Building Submittals:

1. Product Data for Mandatory Requirement: Documentation indicating that units comply with applicable requirements in ASHRAE/IESNA 90.1.
2. Product Data for Mandatory Requirement: Documentation indicating that units comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."
3. Product Data for High Performance Building Standard Option Strategy: Documentation indicating that units are equipped with a direct outdoor airflow-

measuring device capable of measuring the minimum outdoor airflow with accuracy within 15 percent of the design minimum airflow rate, as defined by ASHRAE 62.1.

C. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Prepare the following by or under the supervision of a qualified professional engineer:
   a. Details: For securing and flashing roof curb to roof structure. Indicate coordinating requirements with roof membrane system.
   b. Include diagrams for power, signal, and control wiring.
4. Delegated-Design Submittal: For design of vibration isolation seismic restraints and wind restraints, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
5. Unit fabrication and assembly details.
6. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
7. Design Calculations:
   a. Calculate requirements for selecting vibration isolators, seismic restraints and wind restraints and for designing vibration isolation bases.
   b. Indicate compliance with "Performance Requirements" article.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings:
1. Roof-curb mounting details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
2. Size and location of unit-mounted rails and anchor points and methods for anchoring units to roof curb.
3. Required roof penetrations for ducts, pipes, and electrical raceways, including size and location of each penetration.
4. Seismic Qualification Certificates: For dedicated outdoor-air units, accessories, and components, from manufacturer.
5. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
6. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
7. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
8. Startup service reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For units to include in emergency, operation, and maintenance manuals.

1.7 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. Fan Belts: One set for each belt-driven fan.
   2. Filters: One set for each unit.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to replace components of units that fail in materials or workmanship within specified warranty period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS: Subject to compliance with requirements, provide products by one of the following:

A. Daikin.
B. Desert-Aire.
C. Commercial Industrial Air Solutions (CIAS).
D. Innovent.
E. Trane.

2.2 GENERAL

A. Furnish and install where shown on the plans, packaged dehumidification units with design features as specified within this specification. The units shall be provided and installed in strict accordance with the specifications. All units shall be complete with all components and accessories as specified. Any exceptions must be clearly defined. The contractor shall be responsible for any additional expenses that may occur due to any exception made.

2.3 FACTORY TESTING AND QUALITY CONTROL

A. Standard Factory Tests: Units shall be factory run tested to ensure proper functioning of components. Fans shall be factory run tested to ensure structural integrity and proper RPM, and shall be statically and dynamically balanced for continuous operation at the maximum rated fan speed and motor horsepower in accordance with AMCA 204. All electrical circuits shall be tested to ensure correct operation before shipment of unit. Units shall pass quality control and be thoroughly cleaned prior to shipment.

2.4 UNIT CONSTRUCTION DESCRIPTION

A. Housing: Double wall construction with corrosion-protection coating and exterior finish, gasketed and calked weathertight, hinged access doors with neoprene gaskets for inspection and access to internal parts, minimum 1-inch- thick R-7 thermal insulation for outdoor units, knockouts for electrical and piping connections, exterior drain connection, and lifting lugs.
   1. Inlet: Weatherproof hood, with damper for exhaust and supply.
   2. Exhaust: Weatherproof hood, Spring return, two-position, motor-operated damper.
   3. Supply: modulating, motor-operated damper.

2.5 SUPPLY AND EXHAUST FANS

A. Forward-curved, centrifugal fan with spring isolators and insulated flexible duct connections Motor and Drive: Belt driven with adjustable sheaves, motor mounted on adjustable base.

B. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

C. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

D. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 16 Sections.

E. Spring isolators on each fan having 1-inch (25-mm) static deflection.

2.6 DISPOSABLE FILTERS

A. Comply with NFPA 90A.

B. Filter Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lift out from access plenum.

C. Factory-fabricated, viscous-coated, pleated.

D. Thickness: 2 inches (50 mm).

E. Minimum Merv 10, according to ASHRAE 52.2.

F. Media: Fibrous material formed into deep-V-shaped pleats with antimicrobial agent and held by self-supporting wire grid.

G. Galvanized steel with metal grid on outlet side, steel rod grid on inlet side, hinged, and with pull and retaining handles.

2.7 COOLING COILS

A. Rated according to AHRI 410 and ASHRAE 33, and bearing the AHRI label.

B. Access: Fabricate coil section to allow removal and replacement of coil and to allow in-place access for service and maintenance of coil(s).

C. Casing: Manufacturer's standard material.

D. Tubes: Copper.

E. Tube Headers: Copper.

F. Fins: Aluminum.

G. Leak Test: Coils shall be leak tested with air under water at minimum 200 psig.

H. Refrigerant Coils:

1. Single circuit coil.
2. Suction and Distributor: Seamless copper tube with brazed joints.

2.8 HOT GAS REHEAT COILS

A. Access: Fabricate coil section to allow removal and replacement of coil and to allow in-place access for service and maintenance of coil.

B. Copper tubes in a staggered pattern, hydraulically expanded into full collared, plate type aluminum fins. Factory leak tested to 625 psig.

2.9 COOLING-COIL CONDENSATE DRAIN PANS:

A. Fabricated from stainless-steel sheet and sloped in multiple planes to collect and drain condensate from cooling coils, coil piping connections, coil headers, and return bends.

B. Complying with requirements in ASHRAE 62.1-2004.

C. Drain Connections: At low point of pan with minimum 1-1/2 inch threaded nipple.

D. Units with stacked coils shall have an intermediate drain pan to collect and drain condensate from top coil.

2.10 WATER COILS

A. Aluminum fins mechanically bonded to half inch round copper tubes, round copper headers with treaded female adapters.

B. Configuration: Drainable, with threaded plugs for drain and vent, threaded plugs in return bends, and in headers opposite each tube sloped within frame to condensate connections.

C. Coils shall be leak tested with air under water at minimum 200 psig.

D. Rated and certified in accordance with AHRI standard 410.

E. Minimum 16 gage galvanized steel casing.

F. Capacities as indicated on drawing schedule.

G. Access: Fabricate coil section to allow removal and replacement of coil and to allow in-place access for service and maintenance of coil.

2.11 TOTAL ENERGY RECOVERY WHEEL

A. Casing:

1. Steel with standard factory-painted finish.

2. Integral purge section limiting carryover of exhaust air to between 0.05 percent at 1.6-inch wg and 0.20 percent at 4-inch wg differential pressure.
3. Casing seals on periphery of rotor and on duct divider and purge section.
4. Support vertical rotors on grease-lubricated ball bearings having extended grease fittings or permanently lubricated bearings. Support horizontal rotors on tapered roller bearing.

B. Rotor:

1. Aluminum segmented wheel strengthened with radial spokes, with nontoxic, noncorrosive, silica-gel desiccant coating.
2. Polymer segmented wheel strengthened with radial spokes impregnated with non-migrating, water-selective, molecular-sieve desiccant coating.
3. Maximum Solid Size for Media to Pass: 800 micrometer.

C. Drive: Fractional horsepower motor and gear reducer, with internal overload protection and speed changed by variable frequency controller and self-adjusting multilink belt around outside of rotor.

1. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
2. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

D. Controls:

1. Starting relay, factory mounted and wired, and manual motor starter for field wiring.
2. Variable frequency controller, factory mounted and wired, with exhaust-air sensor to vary rotor speed and maintain exhaust temperature above freezing.
3. Pilot-Light Indicator: Display rotor rotation and speed.
4. Speed Settings: Adjustable settings for maximum and minimum rotor speed limits.

2.12 PIPING AND WIRING

A. Fabricate units with space within housing for piping and electrical conduits. Wire motors and controls so only external connections are required during installation.

B. Outdoor Enclosure: NEMA 259, Type 3R enclosure contains replays, starters and terminal strip.

C. Provide non-fused disconnect switch.

2.13 ACCESSORIES

A. Intake weather hood with birdscreen.

B. Exhaust weather hood with birdscreen.

C. Low leakage isolation dampers: Double -walled airfoil blade, extruded aluminum dampers with compressible jamb seals and extruded-vinyl blade edge seals, in opposed blade arrangement with cadmium-plated steel operating rods rotating in sintered bronze or nylon bearings mounted in a single extruded-aluminum frame, with operating rods connected with a common linkage, and electric damper operator factory wired. Leakage rate shall not exceed 5 cfm/sq. ft. at 1-inch wg and 9 cfm/sq. ft. at 4-inch wg.

D. Duct flanges.

E. Hinged access doors with quarter-turn latches.

2.14 REFRIGERANT CIRCUIT COMPONENTS:

A. Number of Refrigerant Circuits: One with tandem compressors.

B. Compressor: Hermetic, scroll, mounted on vibration isolators; with internal overcurrent and high-temperature protection, internal pressure relief, and crankcase heater.

C. Refrigeration Specialties:

1. Refrigerant: R-410A.
2. Expansion valve with replaceable thermostatic element.
3. Refrigerant filter/dryer.
4. Manual-reset high-pressure safety switch.
5. Automatic-reset low-pressure safety switch.
6. Minimum off-time relay.
7. Automatic-reset compressor motor thermal overload.
8. Brass service valves installed in compressor suction and liquid lines.
9. Hot gas by-pass valve.

2.15 AIR COOLED CONDENSER SECTION:

A. Cabinet: Heavy gauge aluminum with one piece side panels.

B. Condenser Coils: Copper tubes in a staggered pattern, hydraulically expanded into full collared, plate type aluminum fins. Factory leak tested to 625 psig.

C. Fan: Up-blast propeller fan with dynamically balanced aluminum blades, steel hub, heavy duty PSC or 3-phase motor, and fan guard.

D. Electrical Panel: Weatherproof panel with motor starter and disconnect switch.

2.16 CONTROLS

A. Units shall include a microprocessor controller, fully programmed, wired and tested at the factory:
1. Controls shall be BACnet compatible and shall interface with new Tridium-Niagra Building Management System being installed as work of this contract. Coordinate requirements with BMS contractor.
2. Provide all controls, sensors, devices, wiring and programming as required to achieve the Sequence of Operation in Section 230993.

3. LCD user interface panel for changing setpoints and monitoring unit operation.

B. Provide factory installed BACnet controller and sensors to monitor and address the following:
   1. Space humidity
   2. OA / Supply air Inlet temperature
   3. OA Temp after the wheel
   4. Mixed air temperature
   5. After cooling coil temp
   6. After heating coil temperature
   7. Supply discharge temperature
   8. Exhaust after wheel temp
   9 Compressor status (each compressor)
   10. RA/ Exhaust Inlet temp
   11. OA/ Supply Filter pressure
   12. RA/ Exhaust Filter pressure
   13. Supply Fan amps
   14. Exhaust Fan Amps
   15. Wheel rotation monitor
   16. Hot water control valve position
   17. OA damper position
   18. Exhaust damper position
   16. Space Temperature
   17. Hot gas reheat status

C. Modulating Wheel Frost Control

   1. Energy wheel shall be supplied with factory programmed VFD for frost control. Outdoor air temperature sensor and pressure switch across energy wheel shall be provided by unit manufacturer to engage frost control. Wheel shall modulate during frost control to eliminate frost.

E. Refrigerant-Cooling-Coils Controls:

   1. Factory-mounted sensor in unit discharge with sensor adjustment located in control panel to control remote condensing unit to maintain temperature or to integral refrigeration circuit.

2.16 ROOF CURBS

A. Furnish units with manufacturer’s seismic roof curb except where vibration isolation roof curbs are indicated on equipment schedule on drawings.

B. Refer to Section 230548 “Vibration Isolation and Seismic Controls for HVAC Piping and Equipment” for seismic requirements.

2.17 CAPACITIES AND CHARACTERISTICS: Refer to Schedule on Drawings.

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 piping, ducts, and electrical systems to verify actual locations of connections before equipment installation.

C. Examine roof curbs and equipment supports for suitable conditions where units will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's rigging and installation instructions for unloading units and moving to final locations.

B. Install and secure units on curbs and coordinate roof penetrations and flashing with roof construction.

C. Install flexible duct connectors. Comply with requirements in Division 23 Section "Air Duct Accessories" for flexible duct connectors.

D. Install vibration isolation and seismic-control devices. Comply with requirements in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" for vibration isolation and seismic-control devices.

E. Coordinate size, installation, and structural capacity of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

F. Coordinate size, location, and installation of unit manufacturer's roof curbs and equipment supports with roof Installer.

G. Install wall- and duct-mounted sensors furnished by manufacturer for field installation. Install control wiring and make final connections to control devices and unit control panel.

H. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.

I. Install drain pipes from unit drain pans to splash block or pad.

J. Drain Piping: PVC Schedule 40. Same size as condensate drain pan connection.

3.3 CONNECTIONS

A. Where installing piping adjacent to units, allow space for service and maintenance.

B. Comply with requirements in Division 23 Section "Hydronic Piping."

C. Install shutoff valve and union or flange on each supply connection and install balancing valve and union or flange on each return connection.

D. Duct Connections:

1. Comply with requirements in Division 23 Section "Metal Ducts."
2. Drawings indicate the general arrangement of ducts.
3. Connect ducts to units with flexible duct connectors. Comply with requirements for flexible duct connectors in Division 23 Section "Air Duct Accessories."

E. Electrical Connections: Comply with requirements for power wiring, switches, and motor controls in Division 26 Sections. Install electrical devices furnished by unit manufacturer but not factory mounted.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Complete installation and startup checks according to manufacturer's written instructions.

C. Verify operation of remote panel including pilot-light operation and failure modes. Inspect the following:

1. Alarms.
2. Inspect casing insulation for integrity, moisture content, and adhesion.
3. Verify that clearances have been provided for servicing.
4. Verify that controls are connected and operable.
5. Verify that filters are installed.
6. Clean coils and inspect for construction debris.
7. Inspect and adjust vibration isolators and seismic restraints.
8. Verify bearing lubrication.
9. Clean fans and inspect fan-wheel rotation for movement in correct direction without vibration and binding.
10. Adjust fan belts to proper alignment and tension.
11. Start unit.
12. Inspect and record performance of interlocks and protective devices including response to smoke detectors by fan controls and fire alarm.
13. Operate unit for run-in period.
14. Calibrate controls.
15. Adjust and inspect high-temperature limits.
16. Inspect outdoor-air dampers for proper stroke.
17. Verify operational sequence of controls.

18. Measure and record the following airflows. Plot fan volumes on fan curve.
    a. Supply-air volume.
    b. Return-air flow.
    c. Outdoor-air flow.

19. After startup, change filters, verify bearing lubrication, and adjust belt tension.
20. Remove and replace components that do not properly operate and repeat startup procedures as specified above.
21. Prepare written report of the results of startup services.

3.5 ADJUSTING

A. Adjust initial temperature and humidity set points.

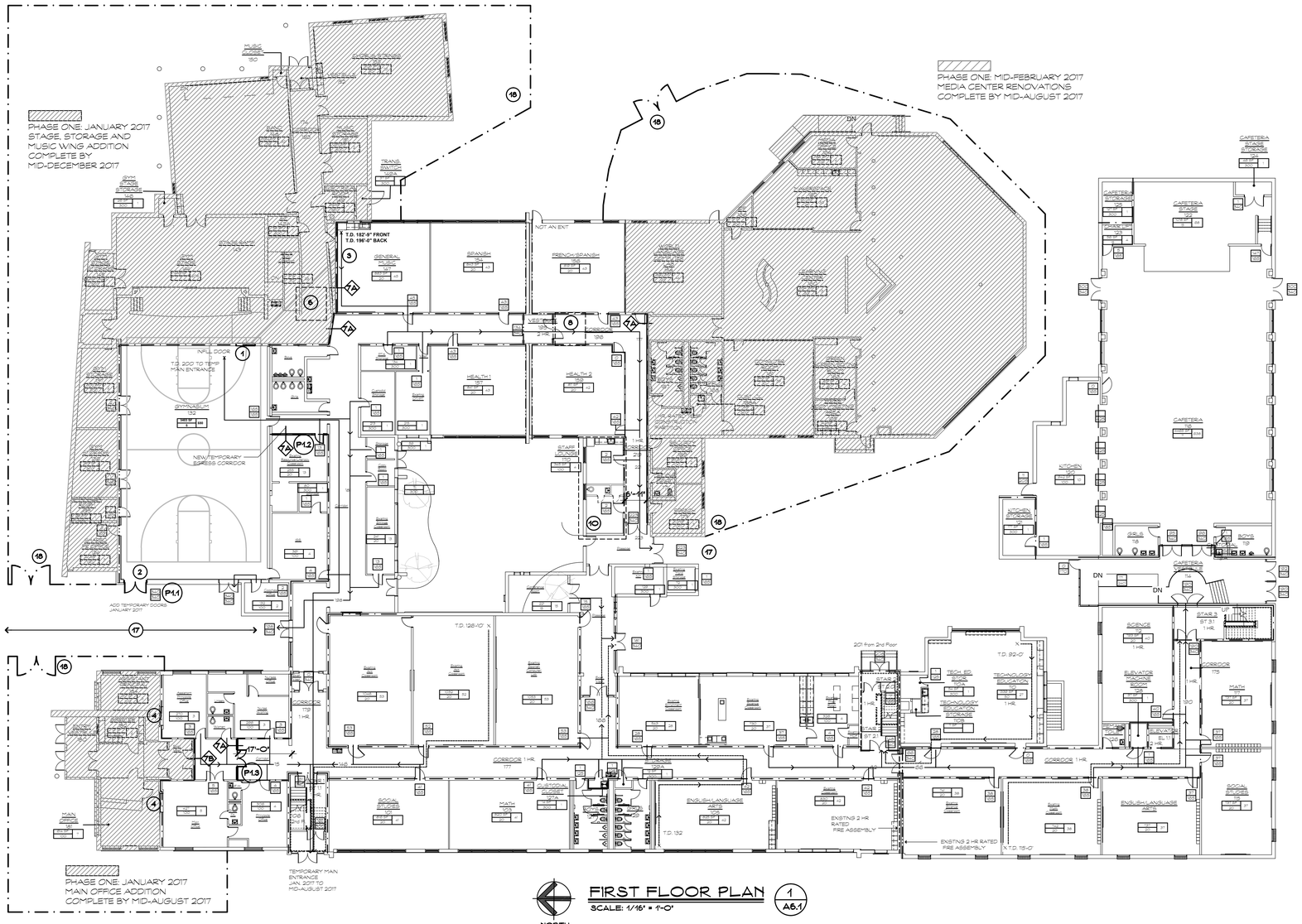
B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 237433

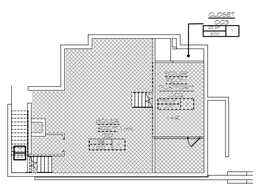


FIRST FLOOR PLAN

SCALE: 1/16" = 1'-0"

1 / A6.1

NORTH



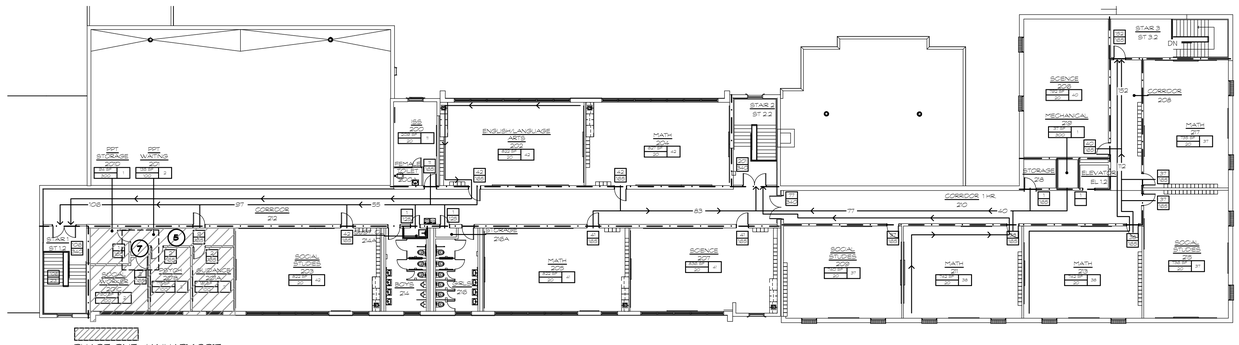
PHASE TWO: EARLY START MID-MAY 2017
BOILER RENOVATIONS COMPLETE BY
END OF SEPTEMBER 2017

BASEMENT PLAN

SCALE: 1/16" = 1'-0"

B / A6.1

NORTH



SECOND FLOOR PLAN

SCALE: 1/16" = 1'-0"

2 / A6.1

NORTH

CODE LEGEND

ROOM NAME 121	ROOM NAME / ROOM NUMBER
840 SF / 20 / 1	AREA IN SF / OCC. LOAD FACTOR / ROOM OCCUPANCY LOAD TAG
42 / 188	EXIT CAPACITY TAG / MAX. ALLOWABLE EGRESS OCC. OF DOOR / ACTUAL EGRESS OCC. OF DOOR
227	- DIRECTION OF TRAVEL W/ ACCUMULATED OCC. LOAD
TD 145	- COMMON PATH OF TRAVEL
128	- MAXIMUM TRAVEL DISTANCE FROM FURTHEST POINT
	- 1 HOUR FIRE RATED WALL AND SMOKE BARRIER
	- 1 HOUR FIRE RATED WALL 7A INTERIOR
	- 1 HOUR FIRE RATED WALL 7B INTERIOR
	- 2 HOUR RATED FIRE SEPARATION ASSEMBLY
	- 2 HOUR FIRE RATED WALL AND SMOKE BARRIER
	- LOT LINE
	- DENOTES ACCESSIBLE THRESHOLD 1/2 MAX STEP WITH BEVELED THRESHOLD OR 1/2 STEP WITHOUT BEVELED THRESHOLD
60.68	- DIMENSION OF OPEN PERIMETER ALONG ENTIRE LONGITUDINAL FACE
(60.68)	- DIMENSION OF NON-OPEN PERIMETER ALONG ENTIRE LONGITUDINAL FACE
	- INDICATES LOSS OF EXIT AS PER BC 1005.11 CT AMENDMENTS
ACR	AREA OF REFUGE. PROVIDE SIGN TYPE S22 ON WALL AT THESE LOCATIONS

PHASING NOTES (1)

1. INFILL EXISTING DOOR WITH PARTITION TYPE 7A
2. TEMPORARY DOOR REQUIRED PRIOR TO CLOSING OFF GYM EXITS. MASONRY OPENING TO BE CREATED TO FINAL SIZE WITH LINTEL AND TEMPORARY WALL TYPE 7B CONSTRUCTED TO TOP OF TEMPORARY DOOR.
3. RATED PARTITION TO BE CONSTRUCTED WHEN SCHOOL IS NOT IN SESSION. REMOVE PORTIONS OF CASEWORK AS REQ'D
4. INFILL EXISTING WINDOWS WITH PARTITION TYPE 7B OR SIM. CONSTRUCTION
5. THIS AREA OF CONSTRUCTION TO BE COMPLETED PRIOR TO REMAINING PHASE 1 WORK.
6. APPROX. LOCATION OF DOAS-1 UNIT WHICH MUST BE POWERED BY A REMOTE FEEDER, AND MADE FULLY OPERATIONAL PRIOR TO OCCUPANCY OF PHASE 1 HATCHED AREAS. PORTIONS OF WORK NEED TO OCCUR IN OCCUPIED CORRIDORS AND CLASSROOMS SEE MECH. DWGS.
7. APPROX. LOCATION OF DOAS-3 UNIT WHICH MUST BE POWERED BY A REMOTE FEEDER, AND MADE FULLY OPERATIONAL PRIOR TO OCCUPANCY OF PHASE 1 HATCHED AREAS. PORTIONS OF WORK NEED TO OCCUR IN OCCUPIED CORRIDORS AND CLASSROOMS SEE MECH. DWGS.
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9. APPROX. LOCATION OF 8'-0" HIGH CONSTRUCTION FENCING TO PUBLIC WAY SEE CIVIL DWGS. FOR MORE INFORMATION
10. CONSTRUCT, MOVE, AND MAKE ANY TEMPORARY CONNECTIONS REQUIRED TO RELOCATE STAFF LOUNGE TO THIS AREA PRIOR TO OBTAINING ROOM 158
11. APPROX. LOCATION OF DOAS-2 UNIT WHICH MUST BE POWERED BY A REMOTE FEEDER, AND MADE FULLY OPERATIONAL PRIOR TO OCCUPANCY OF PHASE 1 HATCHED AREAS. PORTIONS OF WORK NEED TO OCCUR IN OCCUPIED CORRIDORS AND CLASSROOMS
12. APPROX. LOCATION OF DOAS-4 UNIT WHICH MUST BE POWERED BY A REMOTE FEEDER, AND MADE FULLY OPERATIONAL PRIOR TO OCCUPANCY OF PHASE 1 HATCHED AREAS. PORTIONS OF WORK NEED TO OCCUR IN OCCUPIED CORRIDORS AND CLASSROOMS
13. TEMPORARY EGRESS CORRIDOR MAIN CORRIDOR, STAFF LOUNGE, AND MAIN OFFICE SUITES TO BE COMPLETE BY SCHOOL OCCUPANCY SEPT. 2017
14. THIS AREA AND CORRIDOR INTEGRITY MUST BE MAINTAINED WHEN SCHOOL IS IN SESSION. DEMOLITION, COURTYARD, AND FOUNDATIONS AND STRUCTURAL WORK TO BE COMPLETED PRIOR TO OCCUPANCY SEPT. 2017 OR SEPT. 2018
15. SEE PHASE THREE NOTES THIS SHEET. COORDINATE WINDOW REPLACEMENT, ROOFING, TOILET RENOVATIONS, MAJOR RENOVATIONS TO AREA A/AREA C/AREA D CLASSROOMS, ART CLASSROOMS, AND INDIVIDUAL CLASSROOM RENOVATIONS, CHASES AND MECHANICAL, PLUMBING, AND ELECTRICAL WORK WITH SCHOOL SCHEDULES, BREAKS, ABATEMENT REQUIREMENTS, ETC. (THE SCHOOL MUST HAVE TWO MEANS OF EGRESS FROM EVERY SPACE AND ACCESS AND EGRESS FROM WITHIN THE BUILDING TO MEDIA, CAFETERIA, AND MAIN OFFICE AT ALL TIMES.
16. 8'-0" CONTRACTOR CHAIN LINK FENCING WITH GATES AS REQ'D FOR ACCESS AND EGRESS TO CONTRACTOR OCCUPIED AREAS.
17. STONEDUST OR EQUIVALENT LEVEL PATHWAYS TO BE CREATED AS REQUIRED FOR EGRESS TO PUBLIC WAY VERIFY FIELD CONDITIONS

Project Title:

Expansion and Alterations to:
WEST SHORE MIDDLE SCHOOL
70 Kay Avenue, Milford CT 06460

SILVER / PETRUCELLI + ASSOCIATES
Architects/Engineers/Interior Designers

3190 Whitney Avenue, Hamden, CT 06518-2340
Tel. 203 230 9007 Fax. 203 230 8247
silverpetrucelli.com

Revision:	Description:	Date:	Revised By:
1	ADDENDUM #1	11/11/2016	CON

Drawing Title:
Construction Phasing Plans
Phase One, January 2017

State Project Number: TMP-084-JLGB

Date: 8/18/2016
Scale: AS NOTED
Drawn By: PEJ
Project Number: 14.278
Drawing Number: A06.1

PHASE THREE:
JANUARY-MID AUGUST 2018
REMAINDER OF PROJECT
RENOVATION AREAS AND
SCOPE. CLASSROOMS AND
TOILET ROOMS SHALL BE
RENOVATED AROUND THE
SCHOOL SCHEDULE AND
DURING THE SUMMER MONTHS

ROOF REPLACEMENT
JUNE 2017-AUG 2017
JUNE 2018-AUG 2018 IF NEEDED

WINDOW REPLACEMENT
JUNE 2017-AUG 2017
JUNE 2018-AUG 2018 IF NEEDED

SPRINKLER PIPING IN
CORRIDORS AND TECH ED.
CLASSROOM
JUNE 2017-AUG 2017

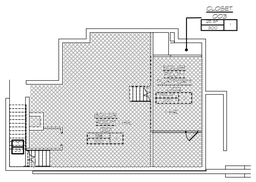
HEAT PIPING REPLACEMENT
JUNE 2017-AUG 2017

REFER TO SITE PLAN C2A FOR
SEQUENCING AND PHASING
REQUIREMENTS

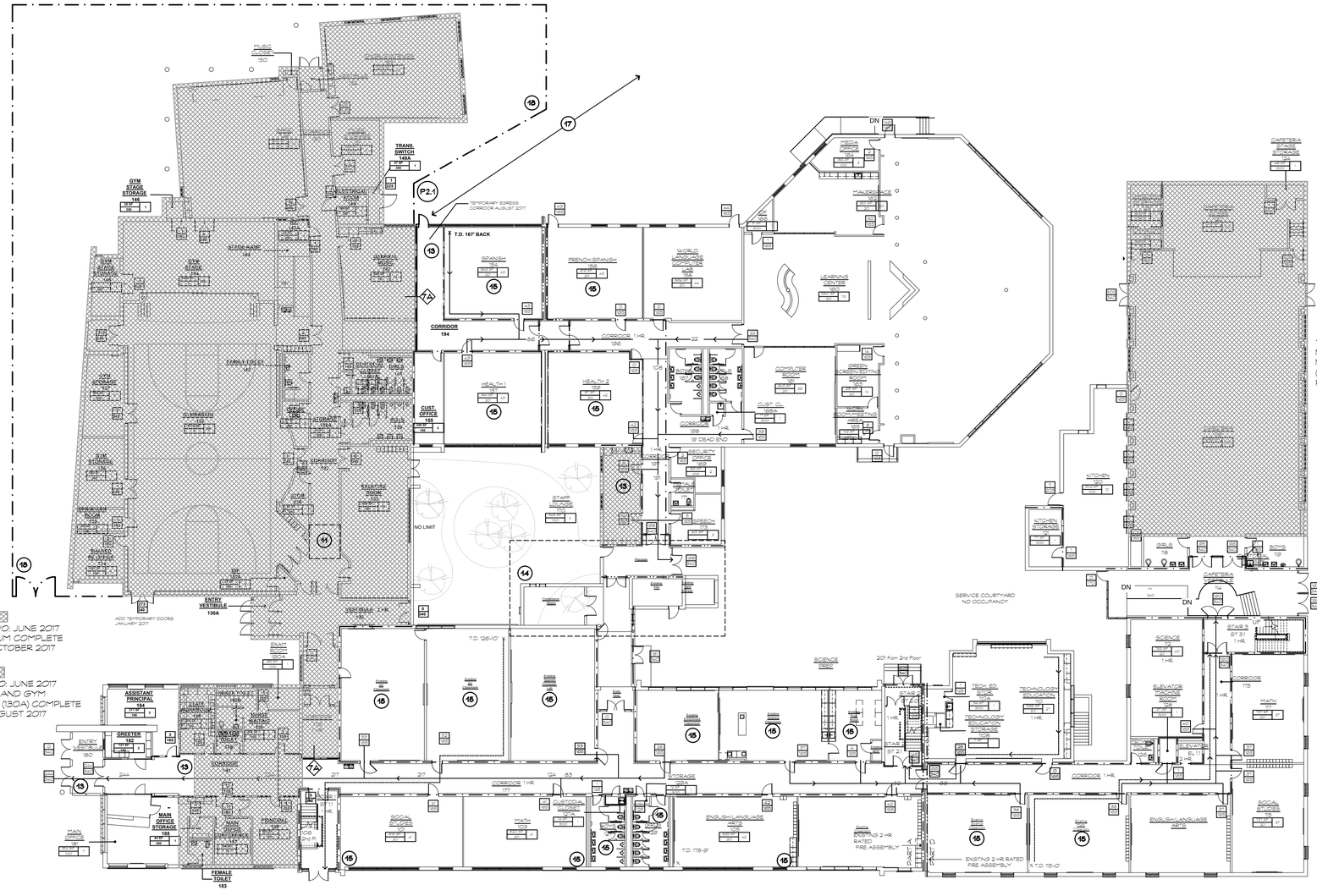
REFER TO ABATEMENT
DRAWINGS FOR SEQUENCING,
REMOVAL AND PHASING
REQUIREMENTS

PHASE TWO: JUNE 2017
GYMNASIUM COMPLETE
BY MID-OCTOBER 2017

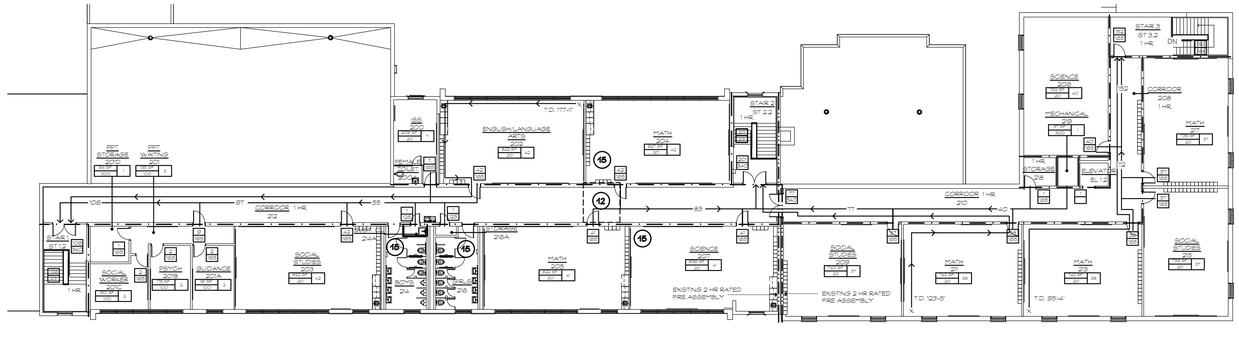
PHASE TWO: JUNE 2017
CORRIDOR AND GYM
VESTIBULE (130A) COMPLETE
BY MID-AUGUST 2017



PHASE TWO: EARLY START MID-MAY 2017
BOILER RENOVATIONS COMPLETE BY
END OF SEPTEMBER 2017



FIRST FLOOR PLAN (1 / A6.2)
SCALE: 1/16" = 1'-0"
NORTH



SECOND FLOOR PLAN (2 / A6.2)
SCALE: 1/16" = 1'-0"
NORTH

BASEMENT PLAN (B / A6.2)
SCALE: 1/16" = 1'-0"
NORTH

CODE LEGEND

ROOM NAME 101	ROOM NAME / ROOM NUMBER
840 SF / 20	AREA IN SF / OCC. LOAD FACTOR
1	ROOM OCCUPANCY LOAD TAG
42	EXIT CAPACITY TAG
168	MAX. ALLOWABLE EGRESS OCC. OF DOOR
	ACTUAL EGRESS OCC. OF DOOR
122	- DIRECTION OF TRAVEL W/ ACCUMULATED OCC. LOAD
TD 145	- COMMON PATH OF TRAVEL
198	- MAXIMUM TRAVEL DISTANCE FROM FURTHEST POINT
	- 1 HOUR FIRE RATED WALL AND SMOKE BARRIER
	- 1 HOUR FIRE RATED WALL 7A INTERIOR
	- 1 HOUR FIRE RATED WALL 7B INTERIOR
	- 2 HOUR RATED FIRE SEPARATION ASSEMBLY
	- 2 HOUR FIRE RATED WALL AND SMOKE BARRIER
	- LOT LINE
	- DENOTES ACCESSIBLE THRESHOLD 1/2 MAX STEP WITH BEVELED THRESHOLD OR 1/2 STEP WITHOUT BEVELED THRESHOLD
60.88	- DIMENSION OF OPEN PERIMETER ALONG ENTIRE LONGITUDINAL FACE
(60.88)	- DIMENSION OF NON-OPEN PERIMETER ALONG ENTIRE LONGITUDINAL FACE
X	- INDICATES LOSS OF EXIT AS PER IBC 1005.1.1 CT AMENDMENTS
AGR	AREA OF REFUGE. PROVIDE SIGN TYPE S22 ON WALL AT THESE LOCATIONS

PHASING NOTES (1→)

1. INFILL EXISTING DOOR WITH PARTITION TYPE 7A
2. TEMPORARY DOOR REQUIRED PRIOR TO CLOSING OFF GYM EXITS. MASONRY OPENING TO BE CREATED TO FINAL SIZE WITH LINTEL AND TEMPORARY WALL TYPE 7B CONSTRUCTED TO TOP OF TEMPORARY DOOR.
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11. APPROX. LOCATION OF DOAS-2 UNIT WHICH MUST BE POWERED BY A REMOTE FEEDER, AND MADE FULLY OPERATIONAL PRIOR TO OCCUPANCY OF PHASE 1 HATCHED AREAS. PORTIONS OF WORK NEED TO OCCUR IN OCCUPIED CORRIDORS AND CLASSROOMS
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Project Title:
Expansion and Alterations to:
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70 Kay Avenue, Milford CT 06460

SILVER / PETRUCELLI + ASSOCIATES
Architects/Engineers/Interior Designers
3190 Whitney Avenue, Hamden, CT 06518-2340
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silverpetrucelli.com

Revision:	Description:	Date:	Revised By:
1	ADDENDUM #1	11/11/2016	CON

Drawing Title:
Construction Phasing Plans
Phase Two

State Project Number: TMP-084-JLGB

Date: 8/25/2016
Scale: AS NOTED
Drawn By: PEJ
Project Number: 14.278

A06.2

SYMBOL LEGEND

- EXISTING PARTITIONS
- NEW METAL STUD PARTITIONS
- NEW MASONRY WALL (4" BRICK VENEER)
- NEW CMU WALL

Room name 101 — ROOM NAME / ROOM NUMBER

101 — DOOR NUMBER

X — DEMOLITION NOTE

1 A101 SIM — DETAIL NUMBER / DRAWING NUMBER

1 — CONSTRUCTION NOTE

1 A101 SIM — SECTION/DETAIL NUMBER / DRAWING NUMBER

A101 SIM — WALL SECTION NUMBER / DRAWING NUMBER

Ref A101 Ref Ref Ref — INTERIOR/EXTERIOR ELEVATION / DRAWING NUMBER

B3.2 — ELEVATION REFERENCE/ REFERENCE POINT WALL TYPE

1 — ELEVATION NOTE

A — COLUMN LINE IDENTIFICATION

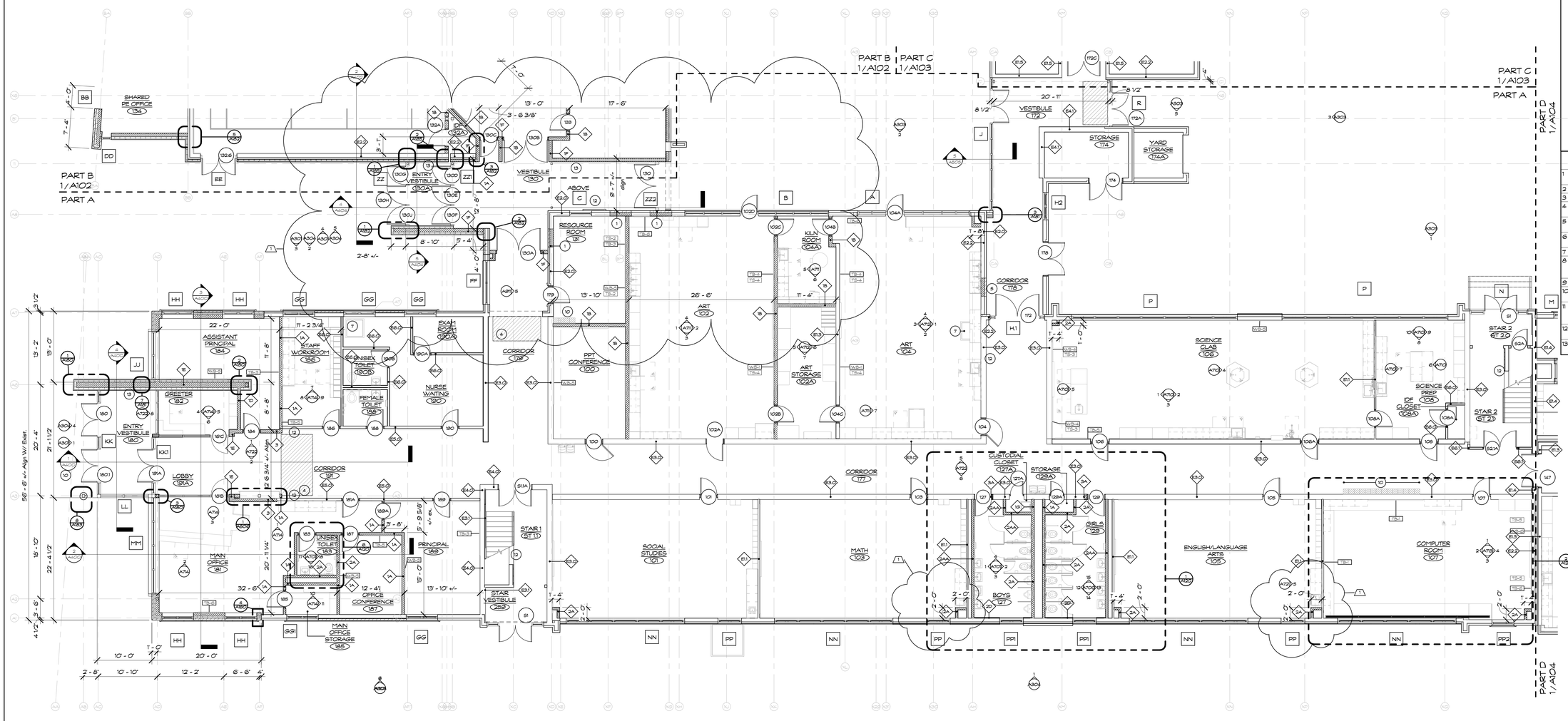
W — WINDOW ELEVATION

C.J. — CONTROL JOINT

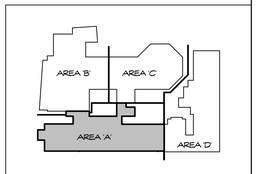
P ACR — 2'-8" x 4'-0" AREA OF REFUGE

CONSTRUCTION NOTES 1

1	NEW AREAWAY WITH ACCESS DOOR SEE PROJ. MAN.
2	CURTAIN DIVIDER SEE ELEC. AND PROJ. MAN
3	INFILL TO MATCH EX. SEE PART. AND CODE PLANS
4	INFILL EXISTING 2' +/- RECESS FROM WALK OFF MAT WITH SELF LEVELING CONCRETE
5	INFILL EXTERIOR WALL AS REQD COORD. WITH DEMO
6	INFILL EXTERIOR WALL WITH METAL FURRING AND GYPSUM
7	NEW RATED ACCES DOOR IN EXISTING LOCATION
8	STICK PN 4' RGID INSULATION TO UNDERSIDE OF FLOOR SLAB BETWEEN NEW COR AND EXTERIOR WALL
9	DRINKING FOUNTAIN SEE DETAIL A/A120
10	PROVIDE DRAINAGE SUMP IN CONCRETE SIDEWALK SEE SECTIONS AND PROJ. MAN.
11	INSTALL RELOCATD LOCKERS ON NEW WOOD BASE TO MATCH EXISTING WITH RB TO MATCH ROOM FINISH. REL. UNUSED LOCKERS TO OWNER
12	MASONRY INFILL @ REMOVED OR REPLACED CUH SEE MECH. DWGS.
13	COORDINATE MASONRY OR FRAMED OPENING WITH NEW CUH SEE MECH. DWGS.



NORTH — First Floor Plan - Part A
SCALE: 1/8" = 1'-0"
1 A101



NORTH — KEY PLAN FIRST FLOOR

Project Title:

Expansion and Alterations to:

WEST SHORE MIDDLE SCHOOL

70 Kay Avenue, Milford CT 06460

SILVER / PETRUCELLI + ASSOCIATES
Architects / Engineers / Interior Designers

3190 Whitney Avenue, Hamden, CT 06518-2340
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Revision:	Description:	Date:	Revised By:
1	ADDENDUM #1	11/1/2016	CON

Revision:	Description:	Date:	Revised By:

Drawing Title:

First Floor Plan - Part A

State Project Number: TMP-084-JLGB

Date: 8/18/2016

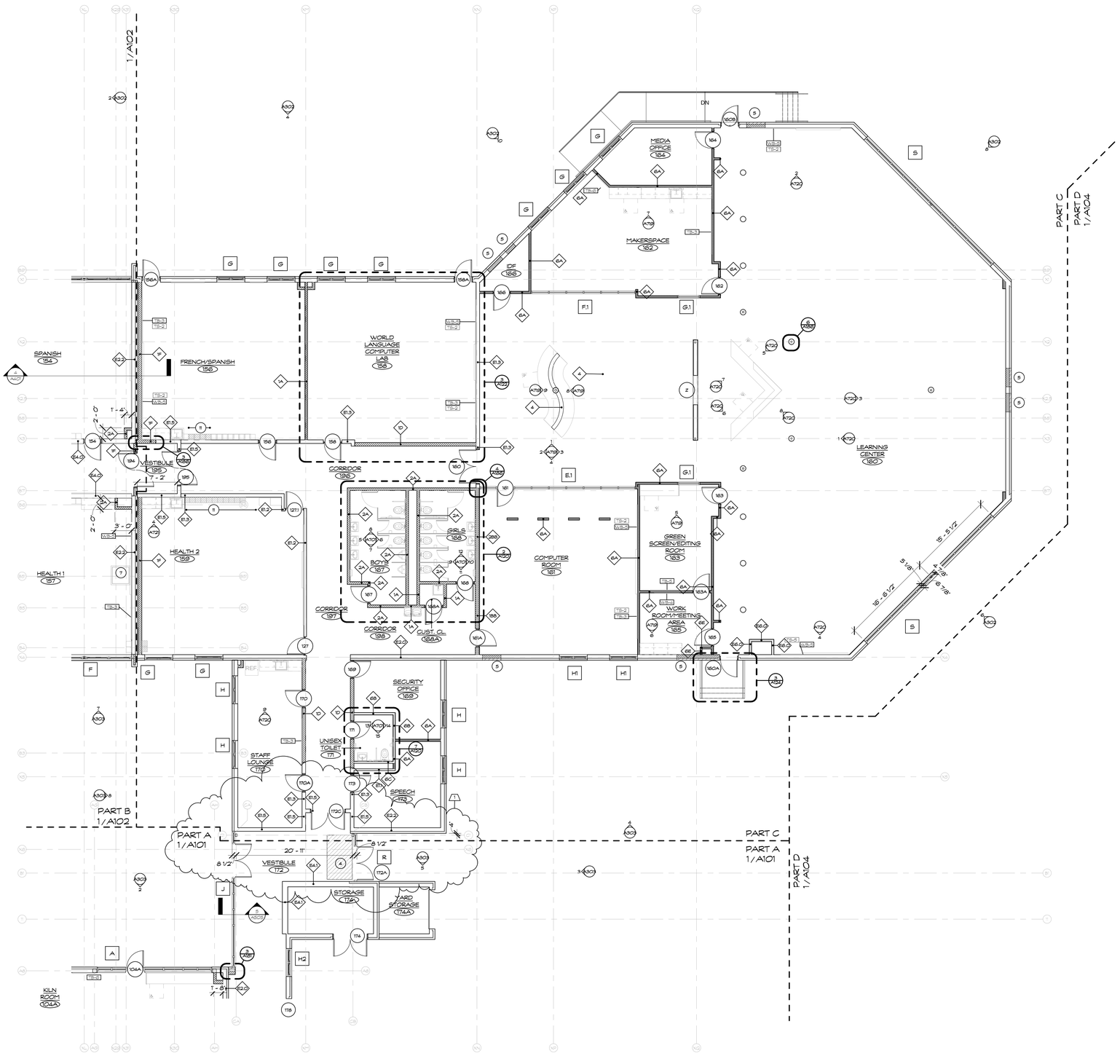
Scale: As indicated

Drawn By: Author

Project Number: 14.278

Drawing Number:

A101



First Floor Plan - Part C

SCALE: 1/8" = 1'-0"

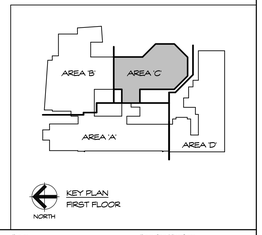
1 A103

SYMBOL LEGEND

- EXISTING PARTITIONS
- NEW METAL STUD PARTITIONS
- NEW MASONRY WALL (4" BRICK VENEER)
- NEW CMU WALL
- Room name 101 — ROOM NAME / ROOM NUMBER
- 101 — DOOR NUMBER
- X — DEMOLITION NOTE
- SIM 1 A101 — DETAIL NUMBER / DRAWING NUMBER
- 1 — CONSTRUCTION NOTE
- SIM 1 A101 — SECTION/DETAIL NUMBER / DRAWING NUMBER
- SIM A101 — WALL SECTION NUMBER / DRAWING NUMBER
- Ref A101 Ref — INTERIOR/EXTERIOR ELEVATION / DRAWING NUMBER
- 103.01 — ELEVATION REFERENCE/ REFERENCE POINT / WALL TYPE
- 1 — ELEVATION NOTE
- A — COLUMN LINE IDENTIFICATION
- 1x — WINDOW ELEVATION
- C.J. — CONTROL JOINT
- ACR — 2'-8" x 4'-0" AREA OF REFUGE

CONSTRUCTION NOTES 1

1	NEW AREAWAY WITH ACCESS DOOR SEE PROJ. MAN.
2	CURTAIN DIVIDER SEE ELEC. AND PROJ. MAN
3	INFILL TO MATCH EX. SEE PART. AND CODE PLANS
4	INFILL EXISTING 2' +/- RECESS FROM WALK OFF MAT WITH SELF LEVELING CONCRETE
5	INFILL EXTERIOR WALL AS REQD COORD. WITH DEMO
6	INFILL EXTERIOR WALL WITH METAL FURRING AND GYPSUM
7	NEW RATED ACCES DOOR IN EXISTING LOCATION
8	STICK PIN 4' RGID INSULATION TO UNDERSIDE OF FLOOR SLAB BETWEEN NEW OOR AND EXTERIOR WALL
9	DRINKING FOUNTAIN SEE DETAIL A/A120
10	PROVIDE DRAINAGE SUMP IN CONCRETE SIDEWALK SEE SECTIONS AND PROJ. MAN.
11	INSTALL RELOCATD LOCKERS ON NEW WOOD BASE TO MATCH EXISTING WITH RB TO MATCH ROOM FINISH. REL. UNUSED LOCKERS TO OWNER
12	MASONRY INFILL @ REMOVED OR REPLACED CUH SEE MECH. DWGS.
13	COORDINATE MASONRY OR FRAMED OPENING WITH NEW CUH SEE MECH. DWGS.



KEY PLAN FIRST FLOOR

Project Title:

Expansion and Alterations to:

WEST SHORE MIDDLE SCHOOL

70 Kay Avenue, Milford CT 06460

SILVER / PETRUCELLI + ASSOCIATES

Architects / Engineers / Interior Designers

3190 Whitney Avenue, Hamden, CT 06518-2340

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Revision:	Description:	Date:	Revised By:
1	ADDENDUM #1	11/1/2016	CON

Revision:	Description:	Date:	Revised By:

Drawing Title: First Floor Plan - Part C

State Project Number: TMP-084-JLGB

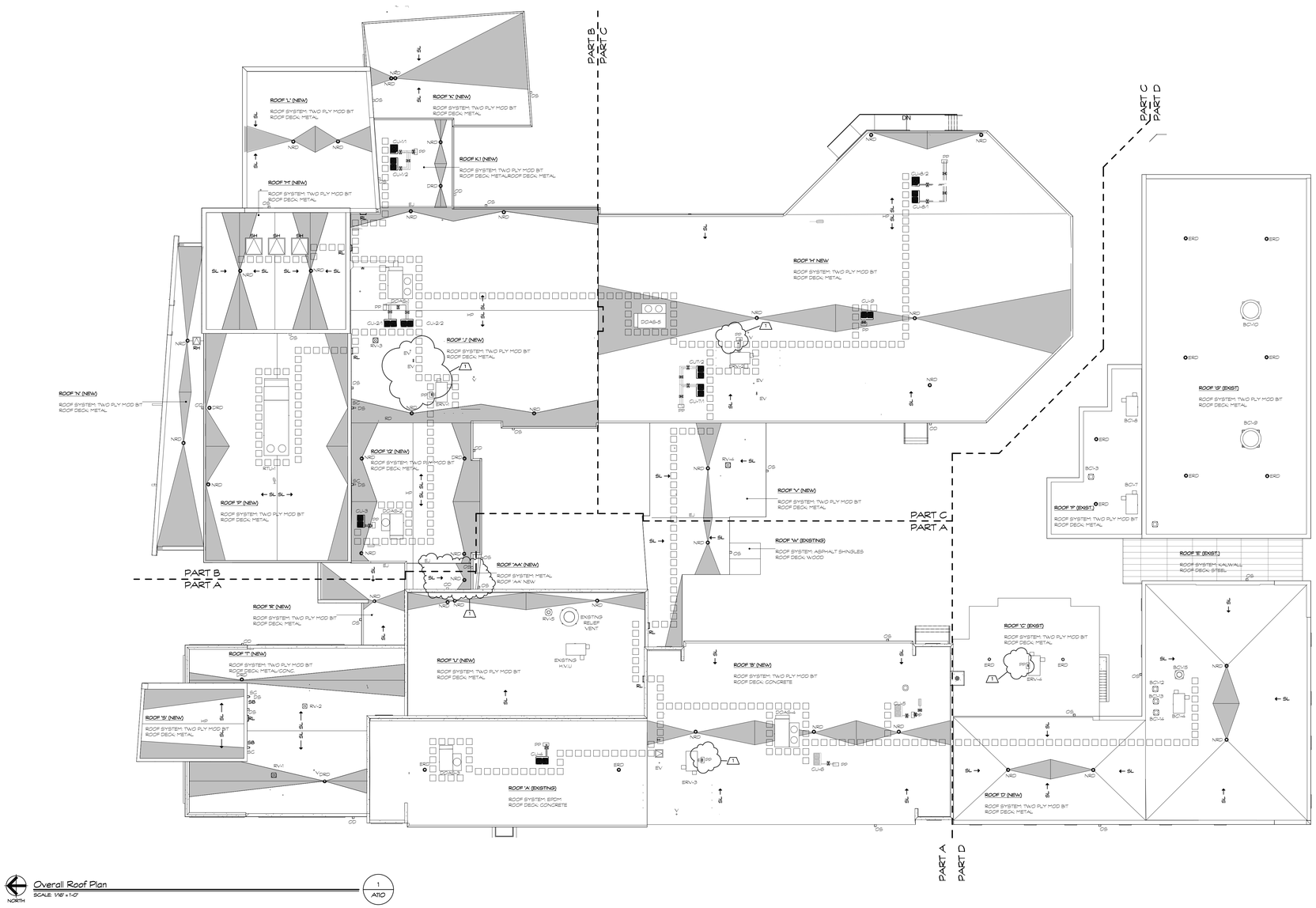
Date: 8/8/2016

Scale: As indicated

Drawn By: Author

Project Number: 14.278

Drawing Number: A103



Overall Roof Plan
SCALE: 1/8" = 1'-0"
1
A110

SYMBOL LEGEND

X/XX - PLAN, SECTION, DETAIL OR ELEVATION NUMBER- SHEET NUMBER

← SL. - INDICATES SLOPE DIRECTION OF TAPERED INSULATION @ 1/4" 1'-0"

H.P. - INDICATES HIGH POINT OF INSULATION.

E.R.D. - EXISTING ROOF DRAIN TO REMAIN

N.R.D. - ROOF DRAIN & SUMP TO BE INSTALLED. SEE DETAIL A/A115

D.R.D. - DUAL ROOF DRAIN & SUMP TO BE INSTALLED. SEE DETAIL B/A115

S.C. - SCUPPER WITH METAL COLLECTION BOX. SEE DETAIL- N/A115

D.S. - METAL DOWNSPOUT. SEE CONSTRUCTION NOTE # 3

S.B. - CONCRETE SPLASH BLOCK. SEE CONSTRUCTION NOTE # 4

V. - VENT STACK. SEE DETAIL- J/A115

EV. - EXHAUST VENT -SEE DETAIL G/A115

DOAS. - MECHANICAL UNIT. -SEE DETAIL L/A115

P.P. - PITCH POCKET. -SEE DETAIL D/A115

□□□ - WALK WAY PADS. -SEE CONSTRUCTION NOTE # 2

E.J. - EXPANSION JOINT. -SEE DETAIL P/A115

R.L. - NEW METAL LADDER. -SEE CONSTRUCTION NOTE #5 AND NOTE M/A115

R.D - ROOF DIVIDER SEE DETAIL H/A115

B.G. - EXISTING MECH. UNIT TO BE FLASHED IN SEE DETAIL E/A115

ERV/RV/EP. - MECH. UNIT SEE DETAIL E/A115

R.D.D. - ROOF DIVIDER. SEE DETAIL H/A115

O.S. - OVERFLOW SCUPPER SEE DETAIL N/A115

S.H. - SMOKE HATCH - SEE DETAIL K/A115

GENERAL NOTES

1. ALL FLAT ROOFS TO RECEIVE 1/4" SLOPE TO EITHER NEW OR EXISTING ROOF AREAS.
2. FIELD VERIFY ALL DIMENSIONS & PERFORM TEST CUTS @ EACH ROOF PRIOR TO BID.
3. ALL MATERIALS ARE NEW UNLESS OTHERWISE NOTED 'EXISTING'.
4. ALL WOOD BLOCKING, PLYWOOD & NAILERS ARE TO BE FIRE TREATED (F.R.T.)
5. ALL WOOD BLOCKING INDICATED IN DETAILS ARE TO BE ANCHORED TO THE EXISTING STRUCTURE.
6. NEW TAPERED INSULATION SYSTEM TO BE ADHERED DIRECTLY TO EXISTING OR NEW DECKING SEE BOTH CONCRETE AND METAL SEE PLAN AND PROJ. MAN.
7. ALL MEMBRANE FLASHING INDICATED IS TO EXTEND A MINIMUM OF 8" (VERTICAL OR HORIZONTAL).
8. CONTRACTOR TO INSPECT THE UNDERSIDE OF ALL ROOFS PRIOR TO ROOFING OPERATIONS TO INSURE THAT NO INTERIOR MATERIALS, EQUIPMENT FINISHES OR OBJECTS WILL BE DAMAGED.
9. CONTRACTOR ASSUMES ALL RESPONSIBILITY DURING PROJECT & WILL REPLACE ANY & ALL DAMAGED EQUIPMENT AT NO ADDITIONAL COST TO THE OWNER.
10. SITE AREAS DISTURBED SHALL BE CLEANED & RELEVELED. W/ LAWN AREAS MAGNETICALLY RAKED TO REMOVE ANY METAL DEBRIS & RE-SEEDED AS REQUIRED TO MATCH ADJACENT CONDITIONS.
11. CONTRACTOR ASSUMES ALL RESPONSIBILITY FOR CLEAN UP OF ROOFING MATERIALS & DEBRIS THAT PENETRATE THE INTERIOR ENVELOPE OF THE BUILDING W/ NO ADDITIONAL COST TO THE OWNER.
12. SNAKE/ CLEAN OUT ALL EXISTING VERTICAL & HORIZONTAL LEADERS OUT TO NEAREST MANHOLE OUTSIDE OF BUILDING.
13. ALL CRICKETS ARE TO BE A MINIMUM OF 1/2 PER FOOT & COORDINATE CRICKETS AROUND EXISTING HVAC UNITS AS REQUIRED TO AVOID PONDING.
14. ALL DRAIN PIPING IS TO BE INSULATED ABOVE THE CEILINGS, THE EXACT ROUTE IS TO BE DETERMINED IN THE FIELD. MAKE MINOR ADJUSTMENTS TO THE ROUTE AT NO ADDITIONAL COST TO THE OWNER.
15. NEW INSULATION TO BE A MINIMUM 3" BASE LAYER BENEATH ALL TAPERED INSULATION.
16. ALL ANTENNAS, CONDUITS & ANY OTHER OBJECTS TO REMAIN AFFECTED BY THE SCOPE OF WORK TO BE TEMPORALLY REMOVED & REINSTALLED.
17. ELEVATION MEASUREMENTS TAKEN FROM TOP OF DECK.
18. ALL ROOFING INSULATION IS RIGID TAPERED WITH PROTECTION BOARD, UNLESS NOTED OTHERWISE

CONSTRUCTION NOTES

1. CONTRACTOR TO CLEAN ALL ROOF AREAS WHERE EXISTING ROOFING SYSTEMS ARE TO REMAIN PRIOR TO THE INSTALLATION OF NEW ROOFING SYSTEM.
2. WALKWAY PADS TO BE INSTALLED @ ALL MECHANICAL UNIT LOCATIONS. CONTRACTOR TO COORDINATE WITH ARCHITECT THE EXACT ROUTE OF PADS IN THE FIELD.
3. INSTALL NEW METAL DOWNSPOUTS @ ALL INDICATED SCUPPER/COLLECTION BOX LOCATIONS. -SEE PROJECT MANUAL FOR ADDITIONAL INFORMATION.
4. INSTALL NEW CONCRETE SPLASH BLOCKS @ ALL INDICATED METAL DOWNSPOUT LOCATIONS. -SEE PROJECT MANUAL FOR ADDITIONAL INFORMATION.
5. CONTRACTOR TO INSTALL NEW METAL LADDER. IF LADDER HEIGHT EXCEEDS 20'-0" THAN A REQUIRED METAL SAFETY CAGE IS TO BE ATTACHED TO THE NEW METAL LADDER. SEE PROJECT MANUAL FOR ADDITIONAL INFORMATION.

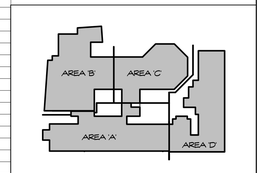
CODE INFORMATION

USE GROUP: E
CONSTRUCTION CLASS: 2B
BASIC WIND SPEED: 110 MPH
SURFACE ROUGHNESS EXPOSURE: B
IMPORTANCE FACTOR: 1.15

FACTORY MUTUAL ENGINEERING & RESEARCH CORPORATION (FM) ROOF ASSEMBLY CLASSIFICATION OF NON-COMBUSTIBLE CONSTRUCTION, WIND UPLIFT REQUIREMENT OF 1-60 FOR FIELD, 1-90 FOR PERIMETER & 1-120 FOR CORNERS, IN ACCORDANCE WITH FM PROPERTY LOSS PREVENTION DATA SHEETS 1-28

ROOF SQ. FOOT

Type Mark	Area
ROOF 'A' (EXISTING)	3,180 SF
ROOF 'AA' (NEW)	24 SF
ROOF 'B' (NEW)	5,952 SF
ROOF 'C' (EXIST)	1,742 SF
ROOF 'E' (EXIST.)	955 SF
ROOF 'F' (EXIST.)	1,127 SF
ROOF 'G' (EXIST)	6,238 SF
ROOF 'H' NEW	12,246 SF
ROOF 'J' (NEW)	5,868 SF
ROOF 'K' (NEW)	1,774 SF
ROOF 'L' (NEW)	1,892 SF
ROOF 'M' (NEW)	1,706 SF
ROOF 'N' (NEW)	1,192 SF
ROOF 'P' (NEW)	3,504 SF
ROOF 'Q' (NEW)	2,137 SF
ROOF 'R' (NEW)	580 SF
ROOF 'S' (NEW)	786 SF
ROOF 'T' (NEW)	3,046 SF
ROOF 'U' (NEW)	3,190 SF
ROOF 'V' (NEW)	2,009 SF
ROOF 'W' (EXISTING)	115 SF
ROOF 'D' (NEW)	6,282 SF
ROOF K.1 (NEW)	718 SF
Grand total	68,223 SF



KEY PLAN
FIRST FLOOR

Project Title:
Expansion and Alterations to:
WEST SHORE MIDDLE SCHOOL
70 Kay Avenue, Milford CT 06460

SILVER / PETRUCELLI + ASSOCIATES
Architects / Engineers / Interior Designers

3190 Whitney Avenue, Hamden, CT 06518-2340
Tel. 203 230 9007 Fax. 203 230 8247
silverpetrucelli.com

Revision:	Description:	Date:	Revised By:
1	ADDENDUM #1	11/1/2016	CON

Revision:	Description:	Date:	Revised By:

Drawing Title:
Overall Roof Plan

State Project Number: TMP-084-JLGB

Date: 8/18/2016
Scale: As indicated
Drawn By: Author
Project Number: 14.218
Drawing Number: A110

SYMBOL LEGEND

X/XX - PLAN, SECTION, DETAIL OR ELEVATION NUMBER- SHEET NUMBER

← SL - INDICATES SLOPE DIRECTION OF TAPERED INSULATION @ 1/4\' 1-0\'

H.P. - INDICATES HIGH POINT OF INSULATION.

E.R.D. - EXISTING ROOF DRAIN TO REMAIN

N.R.D. - ROOF DRAIN & SUMP TO BE INSTALLED. SEE DETAIL A/A115

D.R.D. - DUAL ROOF DRAIN & SUMP TO BE INSTALLED. SEE DETAIL B/A115

S.C. - SCUPPER WITH METAL COLLECTION BOX. SEE DETAIL- N/A115

D.S. - METAL DOWNSPOUT. SEE CONSTRUCTION NOTE # 3

S.B. - CONCRETE SPLASH BLOCK. SEE CONSTRUCTION NOTE # 4

V. - VENT STACK. SEE DETAIL- J/A115

EV. - EXHAUST VENT -SEE DETAIL G/A115

DOAS. - MECHANICAL UNIT. -SEE DETAIL L/A115

P.P. - PITCH POCKET. -SEE DETAIL D/A115

□□□ - WALK WAY PADS. -SEE CONSTRUCTION NOTE # 2

E.J. - EXPANSION JOINT. -SEE DETAIL P/A115

R.L. - NEW METAL LADDER. -SEE CONSTRUCTION NOTE #5 AND NOTE M/A115

R.D - ROOF DIVIDER SEE DETAIL H/A115

BCI. - EXISTING MECH. UNIT TO BE FLASHED IN SEE DETAIL E/A115

ER/RV/EF. - MECH. UNIT SEE DETAIL E/A115

R.D.D. - ROOF DIVIDER. SEE DETAIL H/A115

OS. - OVERFLOW SCUPPER SEE DETAIL N/A115

S.H. - SMOKE HATCH - SEE DETAIL K/A115

GENERAL NOTES

1. ALL FLAT ROOFS TO RECEIVE 1/4\' SLOPE TO EITHER NEW OR EXISTING ROOF AREAS.
2. FIELD VERIFY ALL DIMENSIONS & PERFORM TEST CUTS @ EACH ROOF PRIOR TO BID.
3. ALL MATERIALS ARE NEW UNLESS OTHERWISE NOTED \'EXISTING\'.
4. ALL WOOD BLOCKING, PLYWOOD & NAILERS ARE TO BE FIRE TREATED (F.R.T.)
5. ALL WOOD BLOCKING INDICATED IN DETAILS ARE TO BE ANCHORED TO THE EXISTING STRUCTURE.
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CONSTRUCTION NOTES

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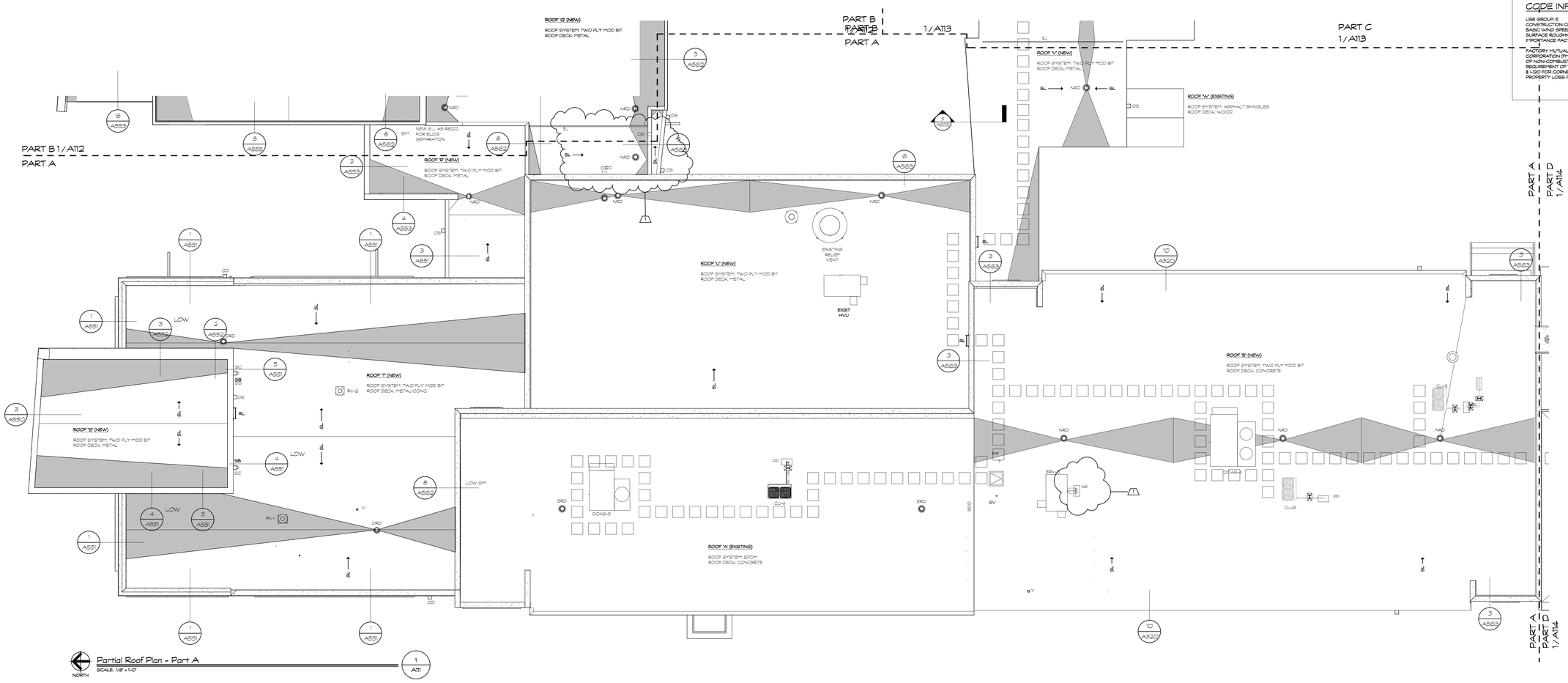
5. CONTRACTOR TO INSTALL NEW METAL LADDER, IF LADDER HEIGHT EXCEEDS 20\'-0\' THAN A REQUIRED METAL SAFETY CAGE IS TO BE ATTACHED TO THE NEW METAL LADDER. SEE PROJECT MANUAL FOR ADDITIONAL INFORMATION.

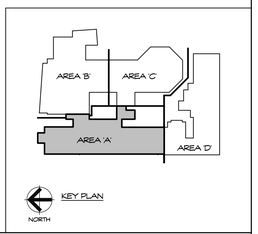
CODE INFORMATION

USE GROUP: E
CONSTRUCTION CLASS: 2B
BASIC WIND SPEED: 90 MPH
SURFACE ROUGHNESS EXPOSURE: B
IMPORTANCE FACTOR: 1.15

FACTORY MUTUAL ENGINEERING & RESEARCH CORPORATION (FM) ROOF ASSEMBLY CLASSIFICATION OF NON-COMBUSTIBLE CONSTRUCTION, WIND UPLIFT REQUIREMENT OF 1-60 FOR FIELD, 1-90 FOR PERIMETER & 1-120 FOR CORNERS, IN ACCORDANCE WITH FM PROPERTY LOSS PREVENTION DATA SHEETS 1-28



Partial Roof Plan - Part A
SCALE: 1/8" = 1'-0"
1 A111



KEY PLAN

Project Title:
Expansion and Alterations to:
WEST SHORE MIDDLE SCHOOL
70 Kay Avenue, Milford CT 06460

SILVER / PETRUCELLI + ASSOCIATES
Architects / Engineers / Interior Designers
3190 Whitney Avenue, Hamden, CT 06518-2340
Tel. 203 230 9007 Fax. 203 230 8247
silverpetrucelli.com

Revision:	Description:	Date:	Revised By:
1	ADDENDUM #1	11/1/2016	CON

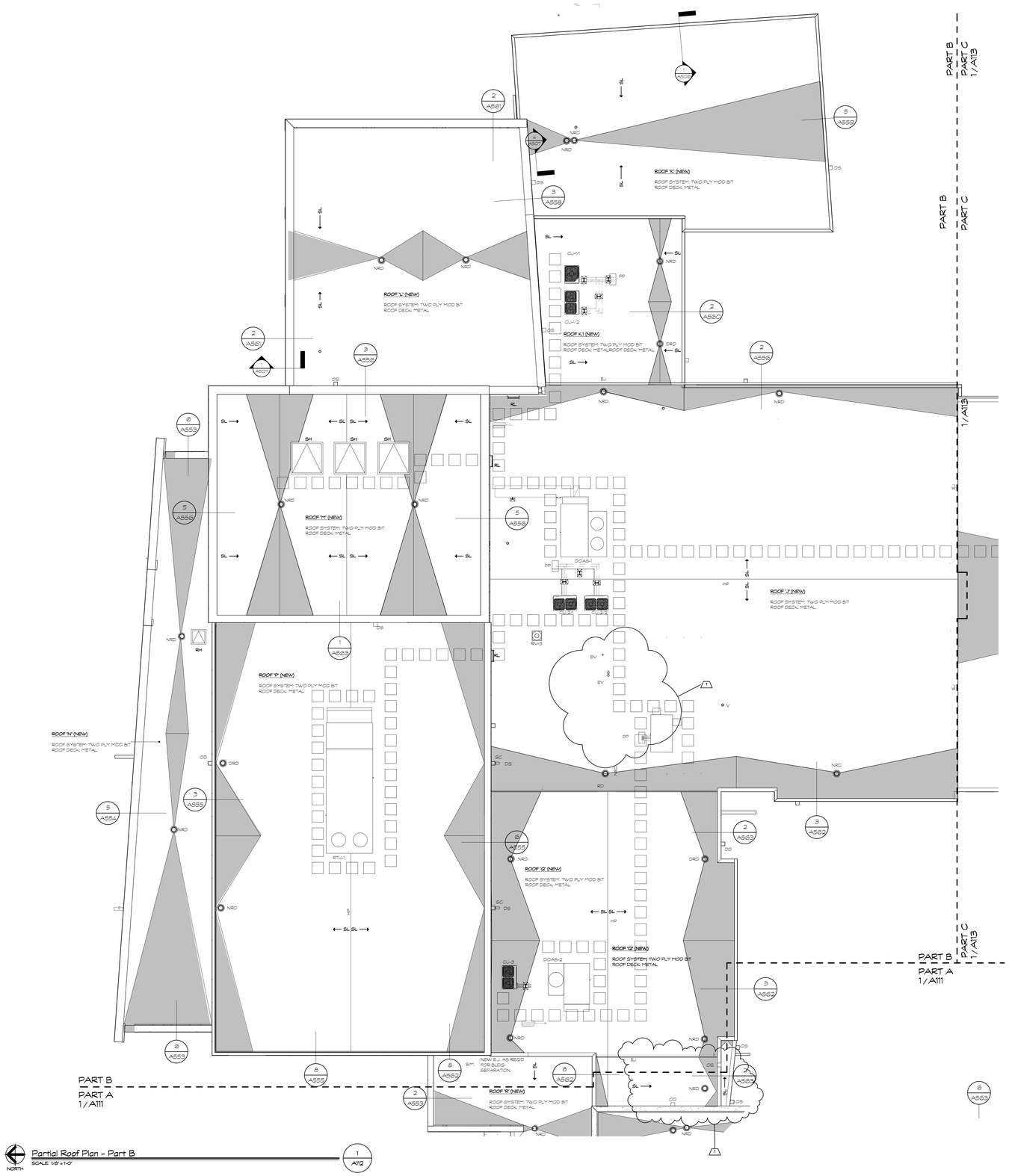
Revision:	Description:	Date:	Revised By:

Drawing Title: Partial Roof Plan - Part A

State Project Number: TMP-084-JLGB

Date: 8/18/2016
Scale: As indicated
Drawn By: Author
Project Number: 14-278

Drawing Number: A111



Partial Roof Plan - Part B
SCALE: 1/8" = 1'-0"
1 / A112

SYMBOL LEGEND

X / XX	- PLAN, SECTION, DETAIL OR ELEVATION NUMBER- SHEET NUMBER
← SL.	- INDICATES SLOPE DIRECTION OF TAPERED INSULATION @ 1/4" / 1'-0"
H.P.	- INDICATES HIGH POINT OF INSULATION.
E.R.D.	- EXISTING ROOF DRAIN TO REMAIN
N.R.D.	- ROOF DRAIN & SUMP TO BE INSTALLED. SEE DETAIL A/A115
D.R.D.	- DUAL ROOF DRAIN & SUMP TO BE INSTALLED. SEE DETAIL B/A115
S.C.	- SCUPPER WITH METAL COLLECTION BOX. SEE DETAIL- N/A115
D.S.	- METAL DOWNSPOUT. SEE CONSTRUCTION NOTE # 3
S.B.	- CONCRETE SPLASH BLOCK. SEE CONSTRUCTION NOTE # 4
V.	- VENT STACK. SEE DETAIL- J/A115
EV.	- EXHAUST VENT -SEE DETAIL G/A115
DOAS.	- MECHANICAL UNIT. -SEE DETAIL L/A115
P.P.	- PITCH POCKET. -SEE DETAIL D/A115
□□□	- WALK WAY PADS. -SEE CONSTRUCTION NOTE # 2
E.J.	- EXPANSION JOINT. -SEE DETAIL P/A115
R.L	- NEW METAL LADDER. -SEE CONSTRUCTION NOTE #5 AND NOTE H/A115
R.D	- ROOF DIVIDER SEE DETAIL H/A115
BCI.	- EXISTING MECH. UNIT TO BE FLASHED IN SEE DETAIL E/A115
ERV/RV/EF.	- MECH. UNIT SEE DETAIL E/A115
R.D.D.	- ROOF DIVIDER. SEE DETAIL H/A115
OS.	- OVERFLOW SCUPPER SEE DETAIL N/A115
S.H.	- SMOKE HATCH - SEE DETAIL K/A115

GENERAL NOTES

1. ALL FLAT ROOFS TO RECEIVE 1/4" SLOPE TO EITHER NEW OR EXISTING ROOF AREAS.
2. FIELD VERIFY ALL DIMENSIONS & PERFORM TEST CUTS @ EACH ROOF PRIOR TO BID.
3. ALL MATERIALS ARE NEW UNLESS OTHERWISE NOTED 'EXISTING'.
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5. ALL WOOD BLOCKING INDICATED IN DETAILS ARE TO BE ANCHORED TO THE EXISTING STRUCTURE.
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9. CONTRACTOR ASSUMES ALL RESPONSIBILITY DURING PROJECT & WILL REPLACE ANY & ALL DAMAGED EQUIPMENT AT NO ADDITIONAL COST TO THE OWNER.
10. SITE AREAS DISTURBED SHALL BE CLEANED & RE-LEVELED, W/ LAWN AREAS MAGNETICALLY RAKED TO REMOVE ANY METAL DEBRIS & RE-SEEDED AS REQUIRED TO MATCH ADJACENT CONDITIONS.
11. CONTRACTOR ASSUMES ALL RESPONSIBILITY FOR CLEAN UP OF ROOFING MATERIALS & DEBRIS THAT PENETRATE THE INTERIOR ENVELOPE OF THE BUILDING W/ NO ADDITIONAL COST TO THE OWNER.
12. FLUSH/ CLEAN OUT ALL EXISTING VERTICAL & HORIZONTAL LEADERS OUT TO NEAREST MANHOLE OUTSIDE OF BUILDING.
13. ALL CRICKETS ARE TO BE A MINIMUM OF 1/2" PER FOOT & COORDINATE CRICKETS AROUND EXISTING HVAC UNITS AS REQUIRED TO AVOID PONDING.
14. ALL DRAIN PIPING IS TO BE INSULATED ABOVE THE CEILINGS, THE EXACT ROUTE IS TO BE DETERMINED IN THE FIELD, MAKE MINOR ADJUSTMENTS TO THE ROUTE AT NO ADDITIONAL COST TO THE OWNER.
15. NEW INSULATION TO BE A MINIMUM 3" BASE LAYER BENEATH ALL TAPERED INSULATION.
16. ALL ANTENNAS, CONDUITS & ANY OTHER OBJECTS TO REMAIN AFFECTED BY THE SCOPE OF WORK TO BE TEMPORARILY REMOVED & REINSTALLED.
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18. ALL ROOFING INSULATION IS RIGID TAPERED WITH PROTECTION BOARD, UNLESS NOTED OTHERWISE

CONSTRUCTION NOTES

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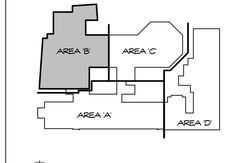
4. INSTALL NEW CONCRETE SPLASH BLOCKS @ ALL INDICATED METAL DOWNSPOUT LOCATIONS. -SEE PROJECT MANUAL FOR ADDITIONAL INFORMATION.
5. CONTRACTOR TO INSTALL NEW METAL LADDER. IF LADDER HEIGHT EXCEEDS 20'-0" THAN A REQUIRED METAL SAFETY CAGE IS TO BE ATTACHED TO THE NEW METAL LADDER. SEE PROJECT MANUAL FOR ADDITIONAL INFORMATION.

CODE INFORMATION

USE GROUP: E
CONSTRUCTION CLASS: 2B
BASIC WIND SPEED: 110 MPH
SURFACE ROUGHNESS EXPOSURE: B
IMPORTANCE FACTOR: 1.15

FACTORY MUTUAL ENGINEERING & RESEARCH CORPORATION (FM) ROOF ASSEMBLY CLASSIFICATION OF NON-COMBUSTIBLE CONSTRUCTION, WIND UPLIFT REQUIREMENT OF 1-60 FOR FIELD, 1-90 FOR PERIMETER & 1-120 FOR CORNERS, IN ACCORDANCE WITH FM PROPERTY LOSS PREVENTION DATA SHEETS 1-28



KEY PLAN

Project Title:
Expansion and Alterations to:
WEST SHORE MIDDLE SCHOOL
70 Kay Avenue, Milford CT 06460

SILVER / PETRUCELLI + ASSOCIATES
Architects / Engineers / Interior Designers
3190 Whitney Avenue, Hamden, CT 06518-2340
Tel. 203 230 9007 Fax. 203 230 8247
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Revision:	Description:	Date:	Revised By:
1	ADDENDUM #1	11/11/2016	CON

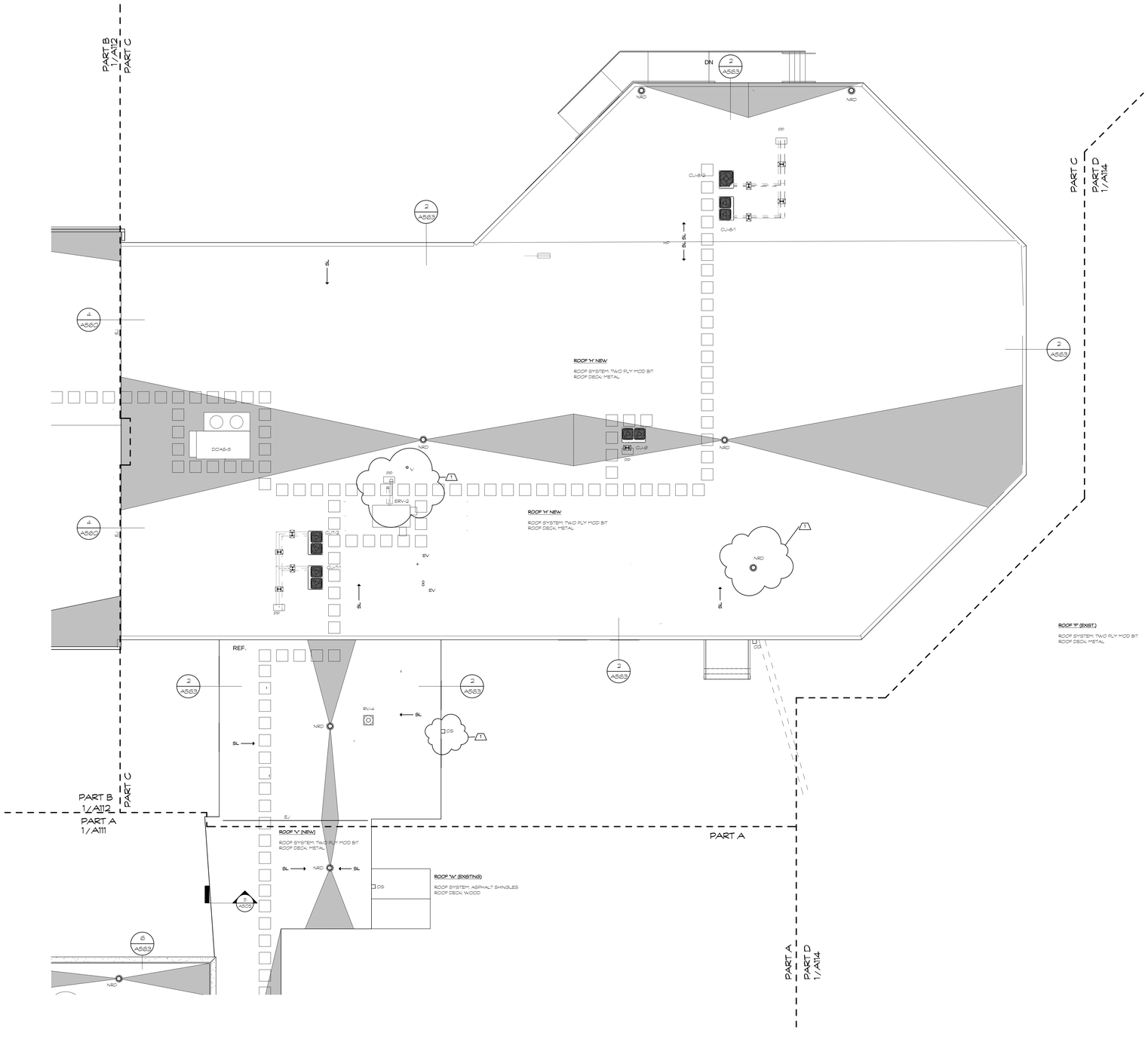
Revision:	Description:	Date:	Revised By:

Drawing Title:
Partial Roof Plan - Part B

State Project Number: TMP-084-JLGB

Date: 8-18-2016
Scale: As indicated
Drawn By: Author
Project Number: 14.278

Drawing Number:
A112



NORTH

Partial Roof Plan - Part C

SCALE: 1/8" = 1'-0"

1
A113

SYMBOL LEGEND

X / XX	- PLAN, SECTION, DETAIL OR ELEVATION NUMBER- SHEET NUMBER
← SL.	- INDICATES SLOPE DIRECTION OF TAPERED INSULATION @ 1/4" / 1'-0"
H.P.	- INDICATES HIGH POINT OF INSULATION.
E.R.D.	- EXISTING ROOF DRAIN TO REMAIN
N.R.D.	- ROOF DRAIN & SUMP TO BE INSTALLED. SEE DETAIL A/A115
D.R.D.	- DUAL ROOF DRAIN & SUMP TO BE INSTALLED. SEE DETAIL B/A115
S.C.	- SCUPPER WITH METAL COLLECTION BOX. SEE DETAIL- N/A115
D.S.	- METAL DOWNSPOUT. SEE CONSTRUCTION NOTE # 3
S.B.	- CONCRETE SPLASH BLOCK. SEE CONSTRUCTION NOTE # 4
V.	- VENT STACK. SEE DETAIL- J/A115
EV.	- EXHAUST VENT -SEE DETAIL G/A115
DOAS.	- MECHANICAL UNIT. -SEE DETAIL L/A115
P.P.	- PITCH POCKET. -SEE DETAIL D/A115
□□□	- WALK WAY PADS. -SEE CONSTRUCTION NOTE # 2
E.J.	- EXPANSION JOINT. -SEE DETAIL P/A115
R.L	- NEW METAL LADDER. -SEE CONSTRUCTION NOTE #5 AND NOTE H/A115
R.D	- ROOF DIVIDER SEE DETAIL H/A115
BCI.	- EXISTING MECH. UNIT TO BE FLASHED IN SEE DETAIL E/A115
ERV/RV/EF.	- MECH. UNIT SEE DETAIL E/A115
R.D.D.	- ROOF DIVIDER. SEE DETAIL H/A115
OS.	- OVERFLOW SCUPPER SEE DETAIL N/A115
S.H.	- SMOKE HATCH - SEE DETAIL K/A115

GENERAL NOTES

1. ALL FLAT ROOFS TO RECEIVE 1/4" SLOPE TO EITHER NEW OR EXISTING ROOF AREAS.
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CODE INFORMATION

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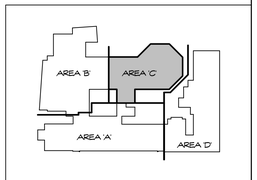
CONSTRUCTION CLASS: 2B
BASIC WIND SPEED: 110 MPH
SURFACE ROUGHNESS EXPOSURE: B
IMPORTANCE FACTOR: 1.15

FACTORY MUTUAL ENGINEERING & RESEARCH CORPORATION (FM) ROOF ASSEMBLY CLASSIFICATION OF NON-COMBUSTIBLE CONSTRUCTION. WIND UPLIFT REQUIREMENT OF 1-60 FOR FIELD, 1-90 FOR PERIMETER & 1-120 FOR CORNERS, IN ACCORDANCE WITH FM PROPERTY LOSS PREVENTION DATA SHEETS 1-28



NORTH

KEY PLAN

Project Title:

Expansion and Alterations to:

WEST SHORE MIDDLE SCHOOL

70 Kay Avenue, Milford CT 06460

SILVER / PETRUCELLI + ASSOCIATES
Architects / Engineers / Interior Designers

3190 Whitney Avenue, Hamden, CT 06518-2340
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Revision:	Description:	Date:	Revised By:
1	ADDENDUM #1	11/11/2016	CON

Revision:	Description:	Date:	Revised By:

Drawing Title:

Partial Roof Plan - Part C

State Project Number: TMP-084-JLGB

Date: 8/18/2016

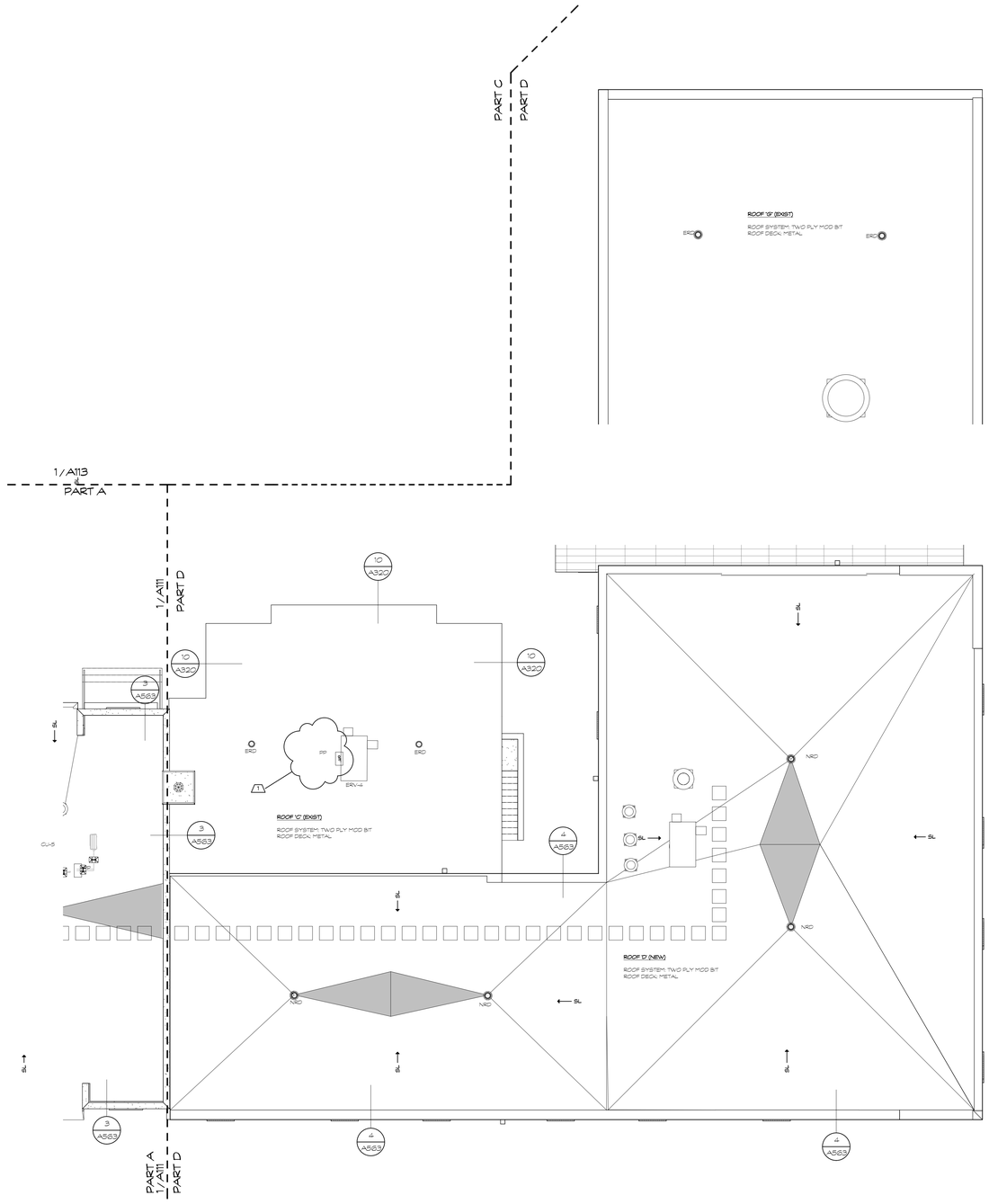
Scale: As indicated

Drawn By: Author

Project Number: 14.278

Drawing Number:

A113



Partial Roof Plan - Part D
SCALE: 1/8" = 1'-0"
NORTH
1 / A114

SYMBOL LEGEND

X / XX - PLAN, SECTION, DETAIL OR ELEVATION NUMBER- SHEET NUMBER

← SL - INDICATES SLOPE DIRECTION OF TAPERED INSULATION @ 1/4" / 1'-0"

H.P. - INDICATES HIGH POINT OF INSULATION.

E.R.D. - EXISTING ROOF DRAIN TO REMAIN

N.R.D. - ROOF DRAIN & SUMP TO BE INSTALLED. SEE DETAIL A/A115

D.R.D. - DUAL ROOF DRAIN & SUMP TO BE INSTALLED. SEE DETAIL B/A115

S.C. - SCUPPER WITH METAL COLLECTION BOX. SEE DETAIL- N/A115

D.S. - METAL DOWNSPOUT. SEE CONSTRUCTION NOTE # 3

S.B. - CONCRETE SPLASH BLOCK. SEE CONSTRUCTION NOTE # 4

V. - VENT STACK. SEE DETAIL- J/A115

EV. - EXHAUST VENT -SEE DETAIL G/A115

DOAS. - MECHANICAL UNIT. -SEE DETAIL L/A115

P.P. - PITCH POCKET. -SEE DETAIL D/A115

□□□ - WALK WAY PADS. -SEE CONSTRUCTION NOTE # 2

E.J. - EXPANSION JOINT. -SEE DETAIL P/A115

R.L. - NEW METAL LADDER. -SEE CONSTRUCTION NOTE #5 AND NOTE M/A115

R.D - ROOF DIVIDER SEE DETAIL H/A115

BCI. - EXISTING MECH. UNIT TO BE FLASHED IN SEE DETAIL E/A115

ERV/RV/EF. - MECH. UNIT SEE DETAIL E/A115

R.D.D. - ROOF DIVIDER. SEE DETAIL H/A115

OS. - OVERFLOW SCUPPER SEE DETAIL N/A115

S.H. - SMOKE HATCH - SEE DETAIL K/A115

GENERAL NOTES

1. ALL FLAT ROOFS TO RECEIVE 1/4" SLOPE TO EITHER NEW OR EXISTING ROOF AREAS.
2. FIELD VERIFY ALL DIMENSIONS & PERFORM TEST CUTS @ EACH ROOF PRIOR TO BID.
3. ALL MATERIALS ARE NEW UNLESS OTHERWISE NOTED 'EXISTING'.
4. ALL WOOD BLOCKING, PLYWOOD & NAILERS ARE TO BE FIRE TREATED (F.R.T.)
5. ALL WOOD BLOCKING INDICATED IN DETAILS ARE TO BE ANCHORED TO THE EXISTING STRUCTURE.
6. NEW TAPERED INSULATION SYSTEM TO BE ADHERED DIRECTLY TO EXISTING OR NEW DECKING SEE BOTH CONCRETE AND METAL SEE PLAN AND PROJ. MAN.
7. ALL MEMBRANE FLASHING INDICATED IS TO EXTEND A MINIMUM OF 8" (VERTICAL OR HORIZONTAL).
8. CONTRACTOR TO INSPECT THE UNDERSIDE OF ALL ROOFS PRIOR TO ROOFING OPERATIONS TO INSURE THAT NO INTERIOR MATERIALS, EQUIPMENT FINISHES OR OBJECTS WILL BE DAMAGED.
9. CONTRACTOR ASSUMES ALL RESPONSIBILITY DURING PROJECT & WILL REPLACE ANY & ALL DAMAGED EQUIPMENT AT NO ADDITIONAL COST TO THE OWNER.
10. SITE AREAS DISTURBED SHALL BE CLEANED & RE-LEVELED. W/ LAWN AREAS MAGNETICALLY RAKED TO REMOVE ANY METAL DEBRIS & RE-SEEDED AS REQUIRED TO MATCH ADJACENT CONDITIONS.
11. CONTRACTOR ASSUMES ALL RESPONSIBILITY FOR CLEAN UP OF ROOFING MATERIALS & DEBRIS THAT PENETRATE THE INTERIOR ENVELOPE OF THE BUILDING W/ NO ADDITIONAL COST TO THE OWNER.
12. SNAKE/ CLEAN OUT ALL EXISTING VERTICAL & HORIZONTAL LEADERS OUT TO NEAREST MANHOLE OUTSIDE OF BUILDING.
13. ALL CRICKETS ARE TO BE A MINIMUM OF 1/2 PER FOOT & COORDINATE CRICKETS AROUND EXISTING HVAC UNITS AS REQUIRED TO AVOID PONDING.
14. ALL DRAIN PIPING IS TO BE INSULATED ABOVE THE CEILINGS. THE EXACT ROUTE IS TO BE DETERMINED IN THE FIELD. MAKE MINOR ADJUSTMENTS TO THE ROUTE AT NO ADDITIONAL COST TO THE OWNER.
15. NEW INSULATION TO BE A MINIMUM 3" BASE LAYER BENEATH ALL TAPERED INSULATION.
16. ALL ANTENNAS, CONDUITS & ANY OTHER OBJECTS TO REMAIN AFFECTED BY THE SCOPE OF WORK TO BE TEMPORARILY REMOVED & REINSTALLED.
17. ELEVATION MEASUREMENTS TAKEN FROM TOP OF DECK.
18. ALL ROOFING INSULATION IS RIGID TAPERED WITH PROTECTION BOARD, UNLESS NOTED OTHERWISE

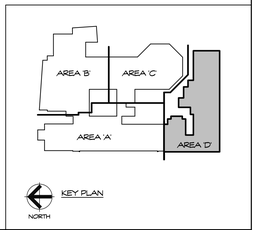
CONSTRUCTION NOTES

1. CONTRACTOR TO CLEAN ALL ROOF AREAS WHERE EXISTING ROOFING SYSTEMS ARE TO REMAIN PRIOR TO THE INSTALLATION OF NEW ROOFING SYSTEM.
2. WALKWAY PADS TO BE INSTALLED @ ALL MECHANICAL UNIT LOCATIONS. CONTRACTOR TO COORDINATE WITH ARCHITECT THE EXACT ROUTE OF PADS IN THE FIELD.
3. INSTALL NEW METAL DOWNSPOUTS @ ALL INDICATED SCUPPER/COLLECTION BOX LOCATIONS. -SEE PROJECT MANUAL FOR ADDITIONAL INFORMATION.
4. INSTALL NEW CONCRETE SPLASH BLOCKS @ ALL INDICATED METAL DOWNSPOUT LOCATIONS. -SEE PROJECT MANUAL FOR ADDITIONAL INFORMATION.
5. CONTRACTOR TO INSTALL NEW METAL LADDER. IF LADDER HEIGHT EXCEEDS 20'-0" THAN A REQUIRED METAL SAFETY CAGE IS TO BE ATTACHED TO THE NEW METAL LADDER. SEE PROJECT MANUAL FOR ADDITIONAL INFORMATION.

CODE INFORMATION

USE GROUP: B
CONSTRUCTION CLASS: 2B
BASIC WIND SPEED: 110 MPH
SURFACE ROUGHNESS EXPOSURE: B
IMPORTANCE FACTOR: 1.15

FACTORY MUTUAL ENGINEERING & RESEARCH CORPORATION (FM) ROOF ASSEMBLY CLASSIFICATION OF NON-COMBUSTIBLE CONSTRUCTION, WIND UPLIFT REQUIREMENT OF 1-60 FOR FIELD, 1-90 FOR PERIMETER & 1-120 FOR CORNERS, IN ACCORDANCE WITH FM PROPERTY LOSS PREVENTION DATA SHEETS 1-28



KEY PLAN

Project Title:

Expansion and Alterations to:
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Revision:	Description:	Date:	Revised By:
1	ADDENDUM #1	11/11/2016	CON

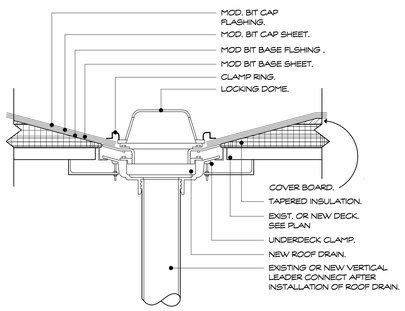
Revision:	Description:	Date:	Revised By:

Drawing Title:
Partial Roof Plan - Part D

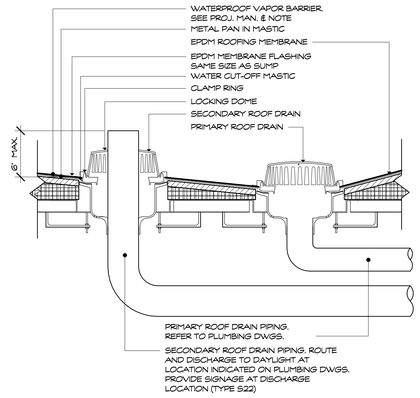
State Project Number: TMP-084-JLGB

Date: 8-18-2016
Scale: As indicated
Drawn By: Author
Project Number: 14.278

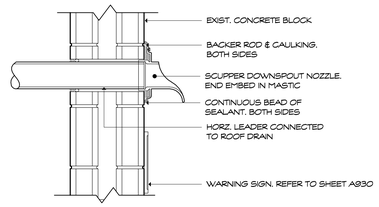
Drawing Number: A114



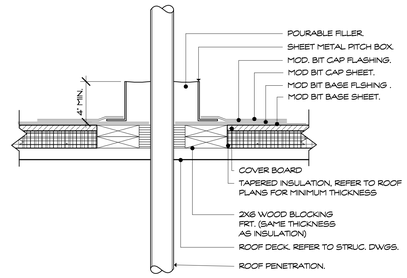
ROOF DRAIN DETAIL (A / A115)
SCALE: 11/2" = 1'-0"



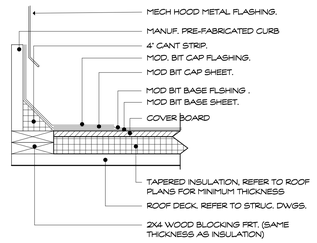
DUAL PRIMARY & SECONDARY ROOF DRAIN (B / A115)
SCALE: 11/2" = 1'-0"



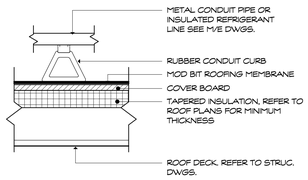
THROUGH WALL SCUPPER DETAIL (C / A115)
SCALE: 11/2" = 1'-0"



PITCH POCKET DETAIL (D / A115)
SCALE: 11/2" = 1'-0"

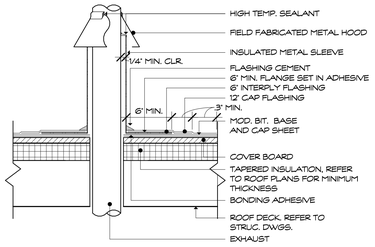


FAN CURB DETAIL (E / A115)
SCALE: 11/2" = 1'-0"

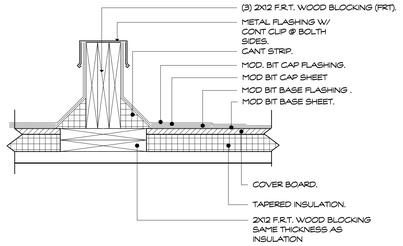


NOTE: ALL INSTALLED W/ CONDUIT PIPE IS TO BE LABELED W/ SERVICE TYPE.

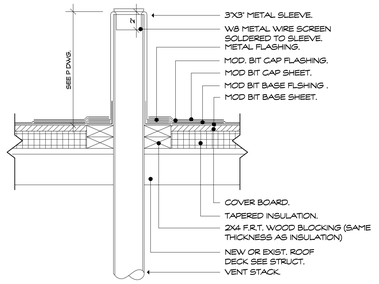
PIPE SUPPORT CURB DETAIL (F / A115)
SCALE: 11/2" = 1'-0"



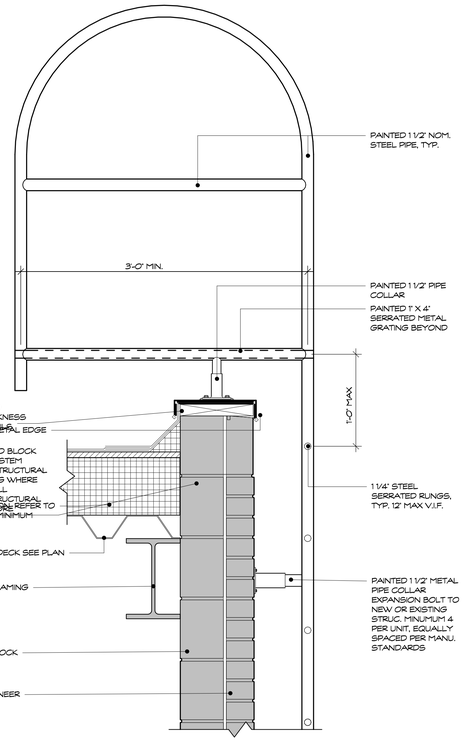
EXHAUST/HOT VENT DETAIL (G / A115)
SCALE: 11/2" = 1'-0"

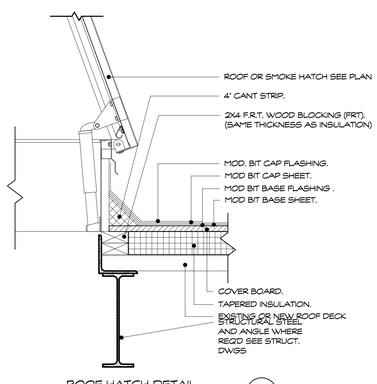


ROOF DIVIDER DETAIL (H / A115)
SCALE: 11/2" = 1'-0"

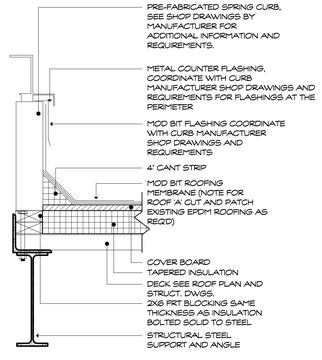


VENT STACK DETAIL (J / A115)
SCALE: 11/2" = 1'-0"

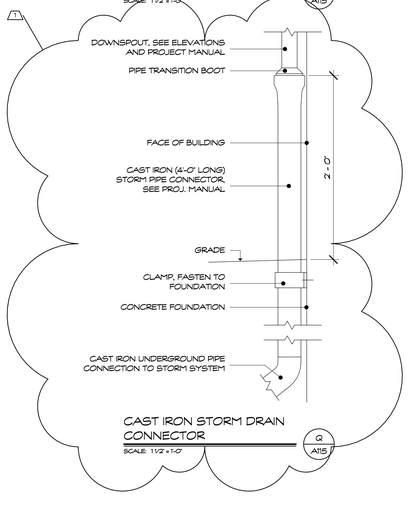




ROOF HATCH DETAIL (K / A115)
SCALE: 11/2" = 1'-0"



DOAS MECH. EQUIP. SPRING CURB (I / A115)
SCALE: 11/2" = 1'-0"



CAST IRON STORM DRAIN CONNECTOR (Q / A115)
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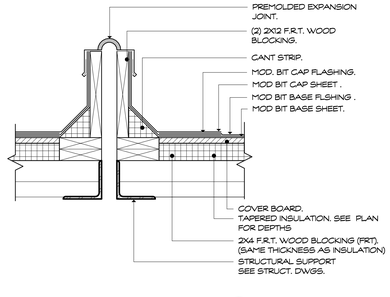
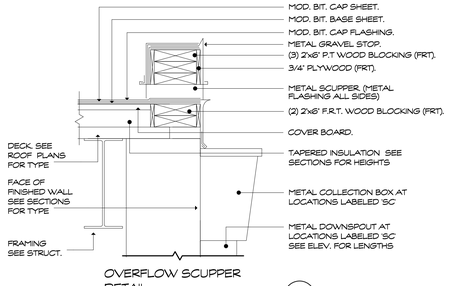
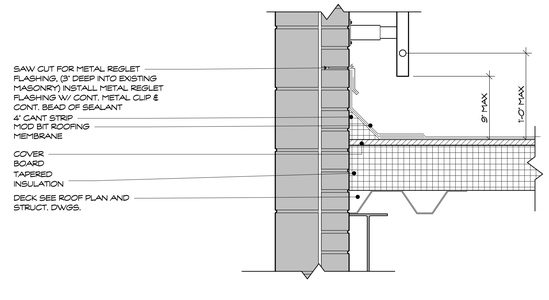


EXPANSION JOINT DETAIL (P / A115)
SCALE: 11/2" = 1'-0"



OVERFLOW SCUPPER DETAIL (N / A115)
SCALE: 11/2" = 1'-0"



ROOF LADDER DETAIL (M / A115)
SCALE: 11/2" = 1'-0"

Project Title:
Expansion and Alterations to:
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Revision:	Description:	Date:	Revised By:
1	ADDENDUM #1	11/11/2016	PEJ

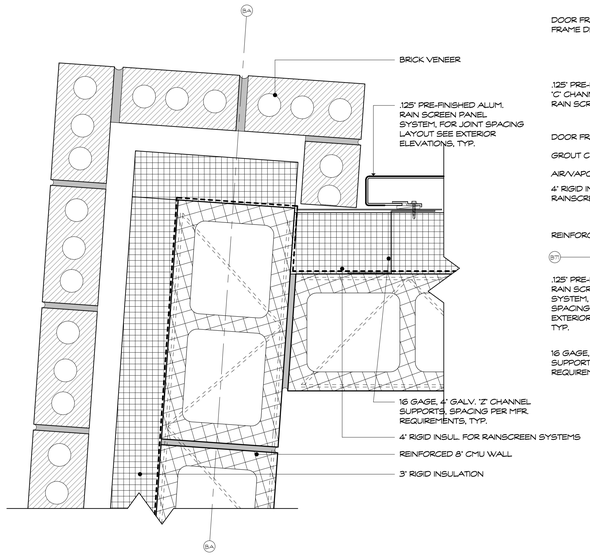
Revision:	Description:	Date:	Revised By:

Drawing Title:
Roof Details

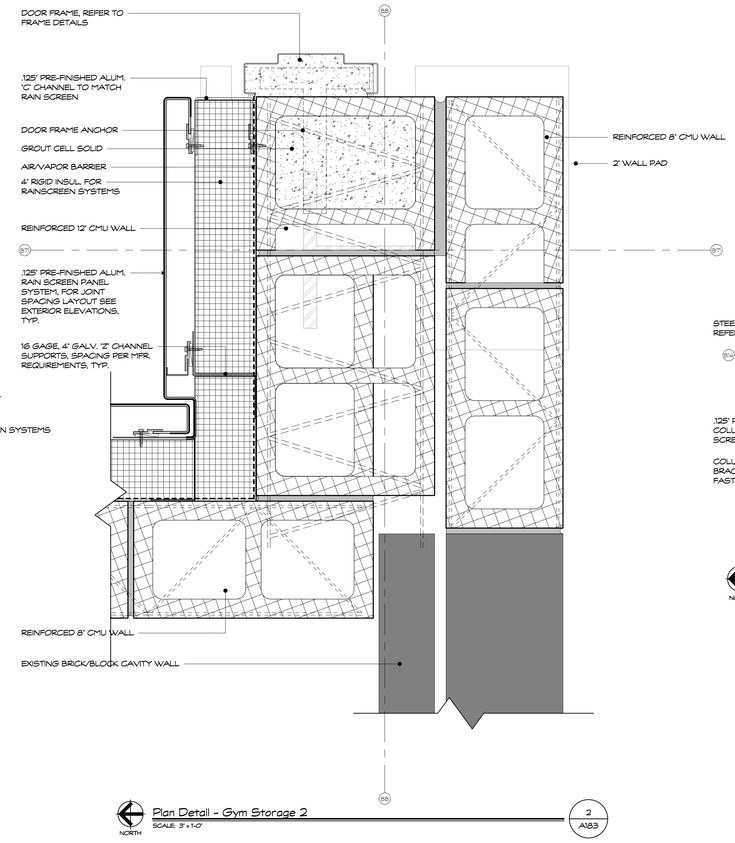
State Project Number: TMP-084-JLGB

Date: 8/18/2016
Scale: 11/2" = 1'-0"
Drawn By: Author
Project Number: 14-278

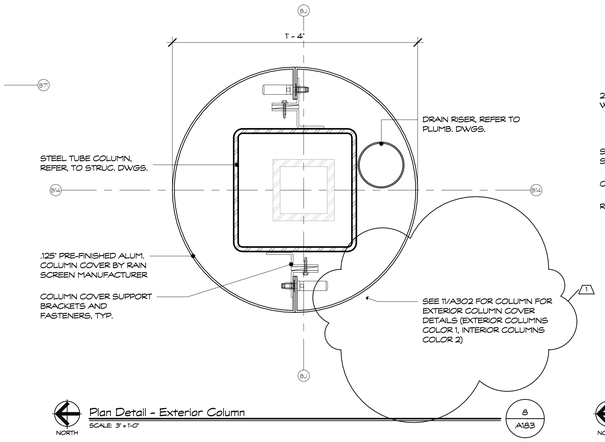
Drawing Number:
A115



Plan Detail - Gym Storage 1 — 1 / A183
SCALE 3' = 1'-0'



Plan Detail - Gym Storage 2 — 2 / A183
SCALE 3' = 1'-0'



Plan Detail - Exterior Column — 8 / A183
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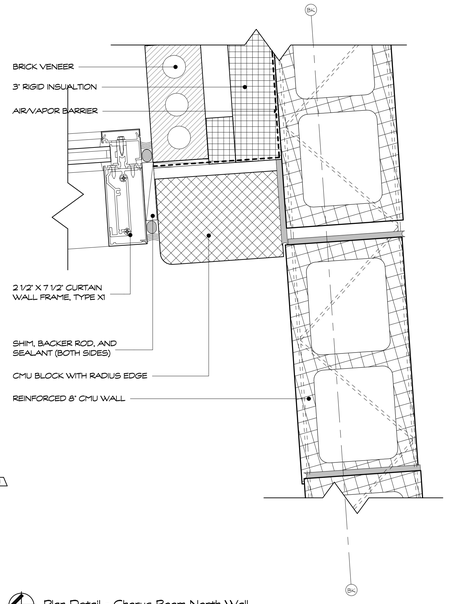
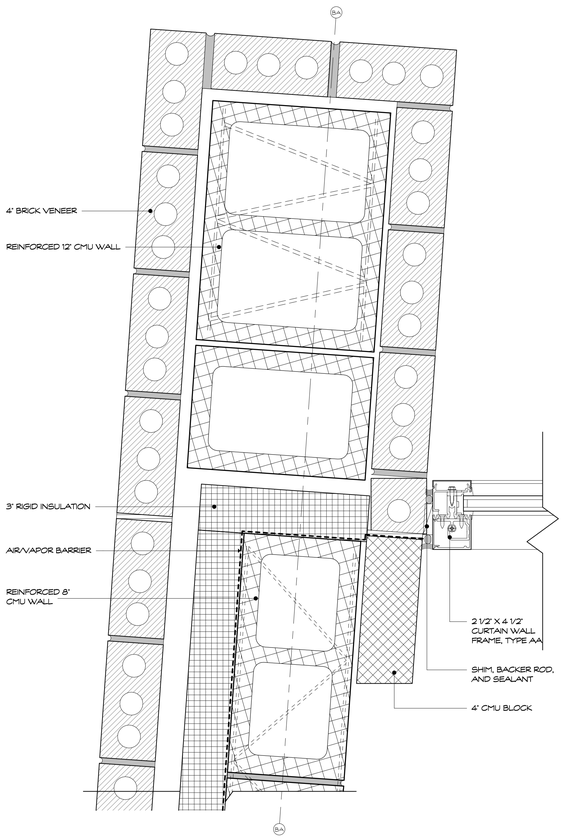


Plan Detail - Chorus Room North Wall — 9 / A183
SCALE 3' = 1'-0'



Plan Detail - Stage Storage North Wall — 3 / A183
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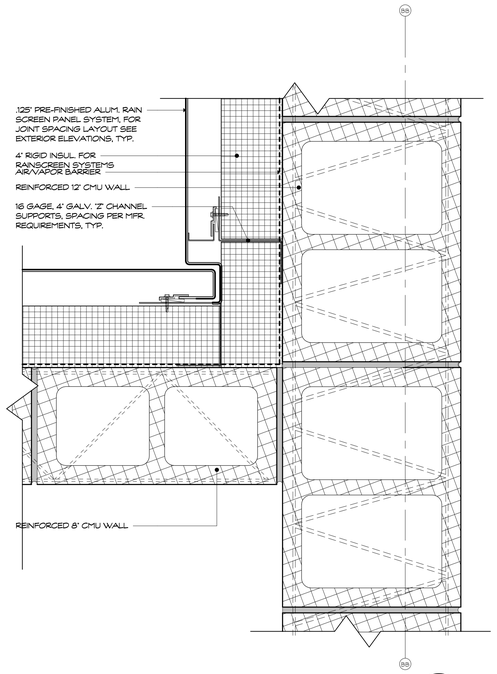

Plan Detail - Stage Storage East Wall — 4 / A183
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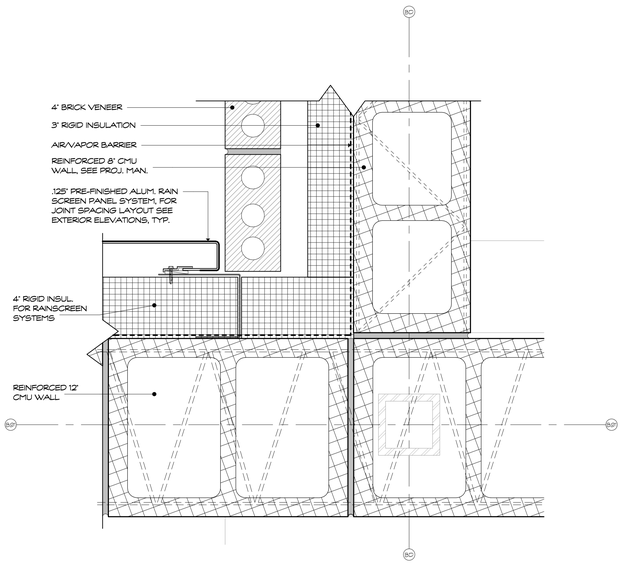

Plan Detail - Stage North Wall — 5 / A183
SCALE 3' = 1'-0'

Project Title:

Expansion and Alterations to:
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Revision:	Description:	Date:	Revised By:
1	ADDENDUM #1	11/11/2016	CON

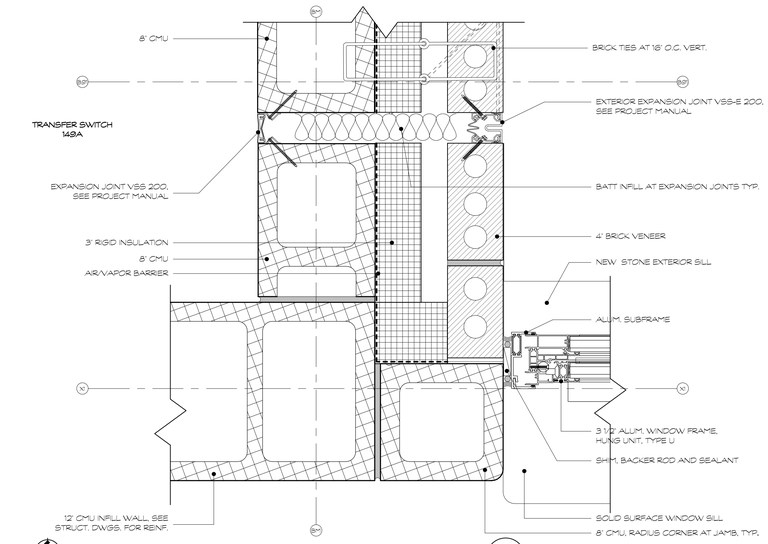
Revision:	Description:	Date:	Revised By:

Drawing Title:
Plan Details - Part 'B'

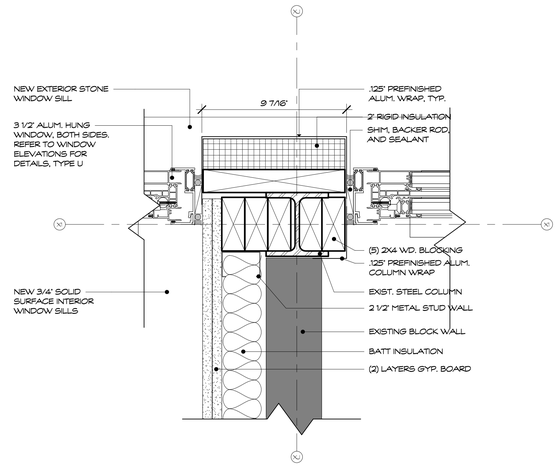
State Project Number: TMP-084-JLGB

Date: 8-18-2016
Scale: 3' = 1'-0'
Drawn By: Author
Project Number: 14.278

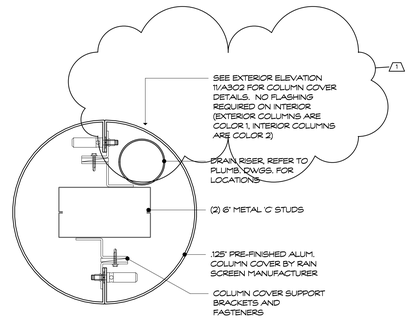
Drawing Number:
A183



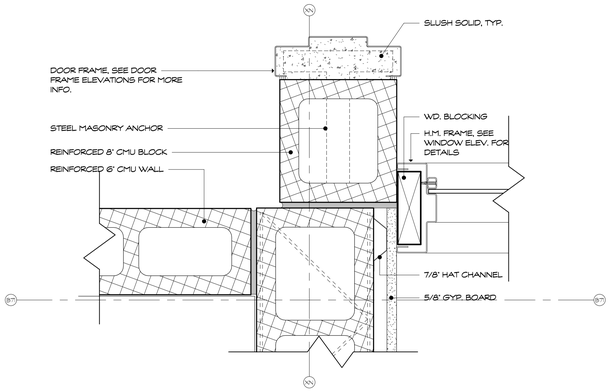
NORTH **Plan Detail - Expansion Joint, Transfer Switch** 1 / A186
SCALE 3" = 1'-0"



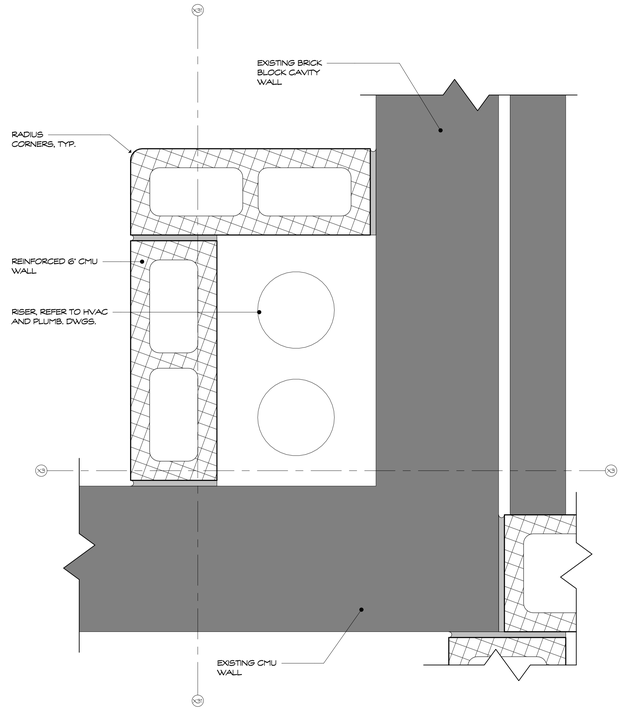
NORTH **Plan Detail - General Music South Wall** 2 / A186
SCALE 3" = 1'-0"



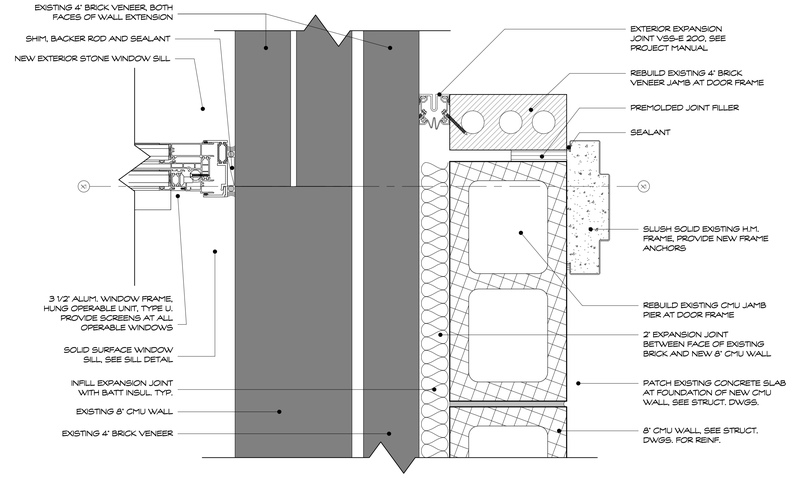
NORTH **Plan Detail - Media Center Column** 6 / A186
SCALE 3" = 1'-0"



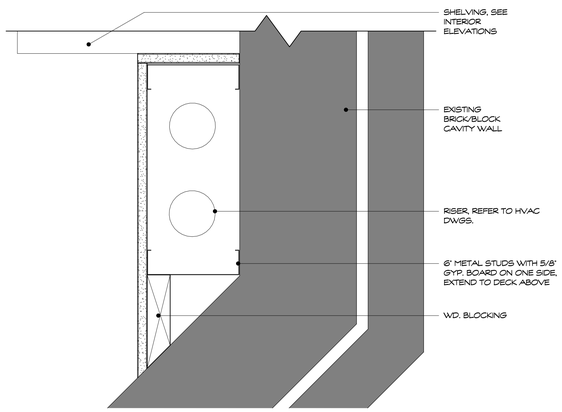
NORTH **Plan Detail - Media Center Entrance** 4 / A186
SCALE 3" = 1'-0"



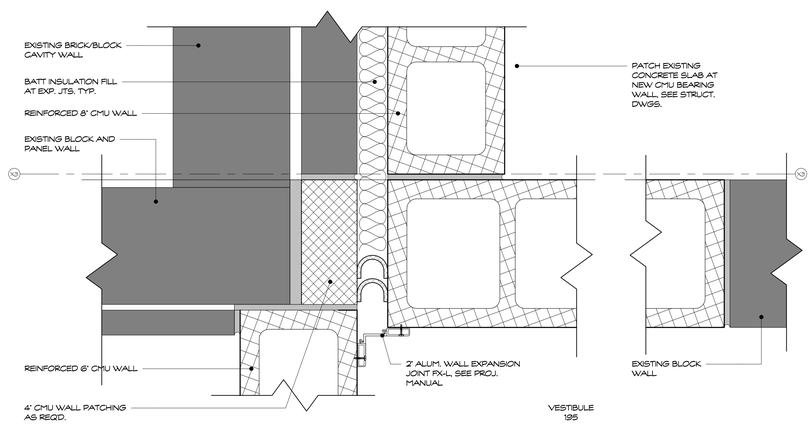
NORTH **Plan Detail - Typical Chase 1** 5 / A186
SCALE 3" = 1'-0"



NORTH **Plan Detail - Expansion Joint East Facade, Part C** 7 / A186
SCALE 3" = 1'-0"



NORTH **Plan Detail - Typical Chase 2** 8 / A186
SCALE 3" = 1'-0"



NORTH **Plan Detail - Vestibule 195 East Wall** 3 / A186
SCALE 3" = 1'-0"

Project Title:
Expansion and Alterations to:
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1	ADDENDUM #1	11/11/2016	CON

Revision:	Description:	Date:	Revised By:

Drawing Title:
Plan Details - Part 'B' & 'C'

State Project Number: TMP-084-JLGB

Date: 8-18-2016
Scale: 3" = 1'-0"
Drawn By: Author
Project Number: 14.278

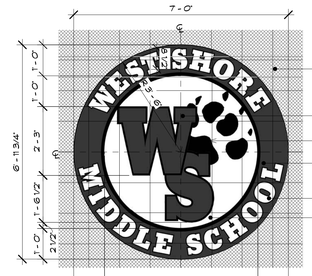
Drawing Number: A186

GENERAL FINISH NOTES

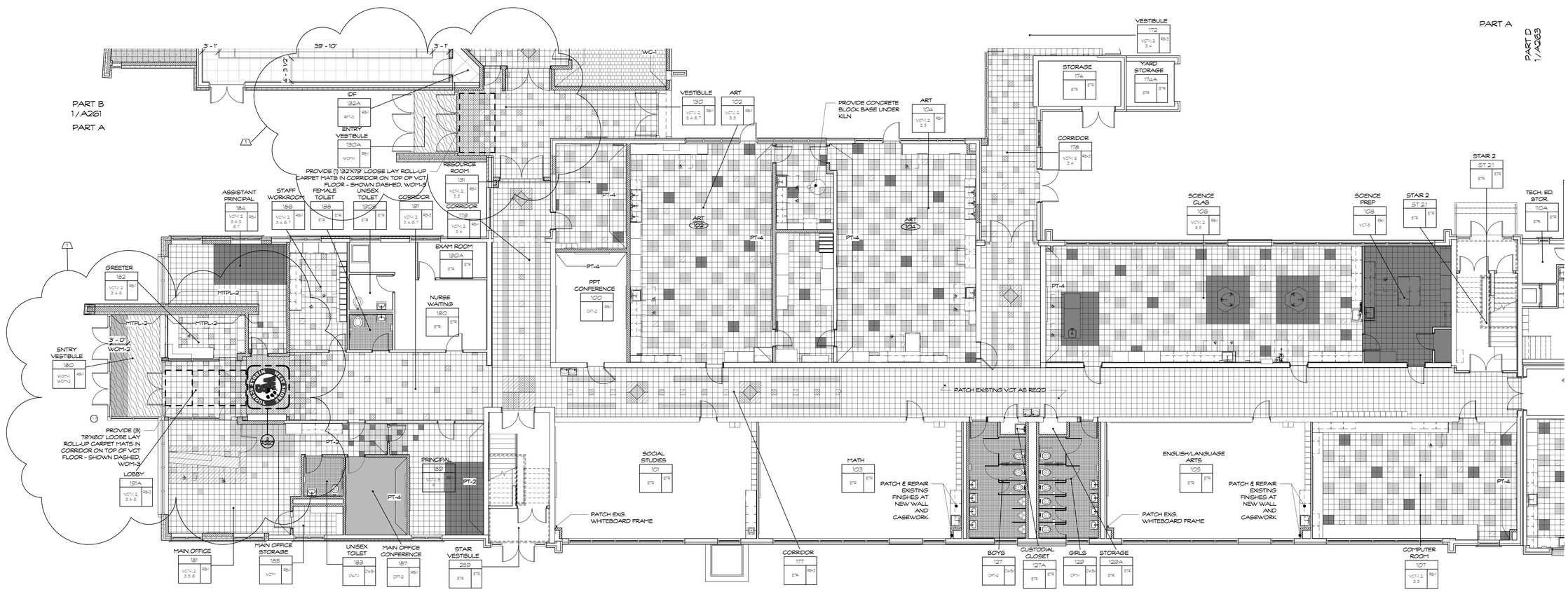
1. ALL WOOD STAINS TO MATCH ARCHITECT'S SAMPLE
2. EXPOSED STRUCTURE TO BE PAINTED PT-1, INCLUDING BUT NOT LIMITED TO ALL DUCTWORK & PIPING, U.O.N.
3. ALL GYPSUM CEILINGS TO BE PAINTED PT-1, U.O.N.
4. PREP ALL SURFACES FOR MATERIAL TO BE APPLIED BASED ON MANUFACTURERS GUIDELINES.
5. REFER TO FLOOR FINISH PLANS FOR SPECIFIC ACCENT PAINT LOCATIONS
6. GYMNASIUM CEILING TO BE PAINTED PT-1, INCLUDING BUT NOT LIMITED TO ALL STRUCTURE, CEILING MOUNTED TECTUM PANELS, DUCTWORK AND PIPING.
7. ALL GUARD RAILS AND HANDRAILS TO BE PAINTED PT-3
8. ALL DOOR FRAMES TO BE PAINTED PT-3
9. IN GYMNASIUM, PROVIDE 2" GAME PAINT LINES IN THE FOLLOWING COLORS:
-BLACK GAME LINE PAINT FOR BASKETBALL COURT LINES
-RED GAME LINE PAINT FOR VOLLEYBALL COURT LINES
-CHARCOAL GAME LINE PAINT FOR BADMINTON/ PICKLEBALL COURT LINES
10. CUT AROUND ADJACENT MECHANICAL PIPING AS REQUIRED AT CASEWORK & FINISH EXPOSED CASEWORK EDGES IF APPLICABLE.
11. PROVIDE STEEL BRACKETS FOR SOLID SURFACE COUNTERTOP SUPPORT EVERY 4'-0" MAX.
12. CONFIRM ALL SPECIFIED MAGNETIC WHITEBOARD AND TACKBOARD SIZES WILL FIT ON TEACHING WALL W/ RELOCATED INTERACTIVE WHITEBOARD PRIOR TO INSTALL.

FLOOR FINISH LEGEND

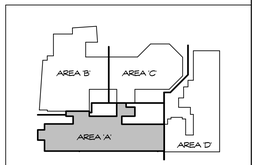
VCT-1	WOM-1
VCT-2	WOM-2
VCT-3	WD-1
VCT-4	EX. FLOOR TO REMAIN
VCT-5	CONC-1
VCT-6	CFT
VCT-7	CPT-1
SFS-1	CPT-2
RBF-1	RFT-1
	LVT-1



NORTH — ENLARGED LOGO (2 / A260)
SCALE: 1/2" = 1'-0"



NORTH — Main Level Finish and Floor Pattern Plan - Part 'A' (1 / A260)
SCALE: 1/8" = 1'-0"



NORTH — KEY PLAN FIRST FLOOR

Project Title:
Expansion and Alterations to:
WEST SHORE MIDDLE SCHOOL
70 Kay Avenue, Milford CT 06460

SILVER / PETRUCELLI + ASSOCIATES
Architects / Engineers / Interior Designers
3190 Whitney Avenue, Hamden, CT 06518-2340
Tel. 203 230 9007 Fax. 203 230 8247
silverpetrucelli.com

Revision:	Description:	Date:	Revised By:
1	ADDENDUM #1	11/11/2016	JET

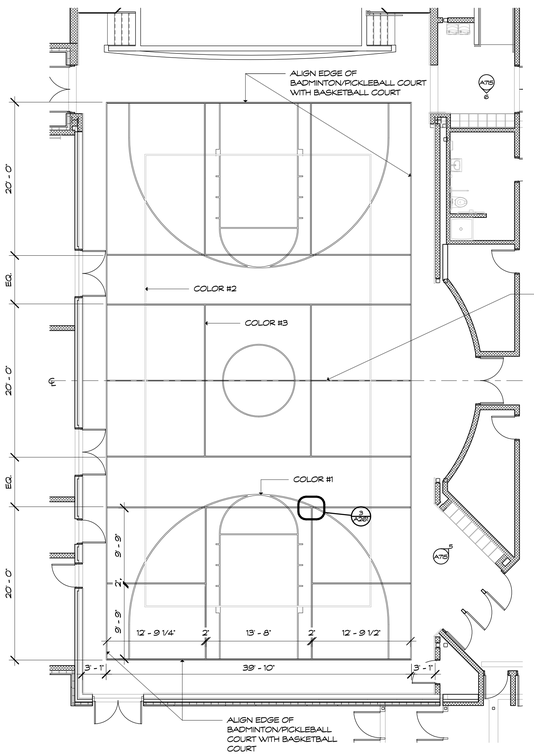
Revision:	Description:	Date:	Revised By:

Drawing Title:
First Floor Finish & Floor Pattern Plan - Part 'A'

State Project Number: TMP-084-JLGB

Date: 8/18/2016
Scale: As indicated
Drawn By: Author
Project Number: 14-278

Drawing Number: A260

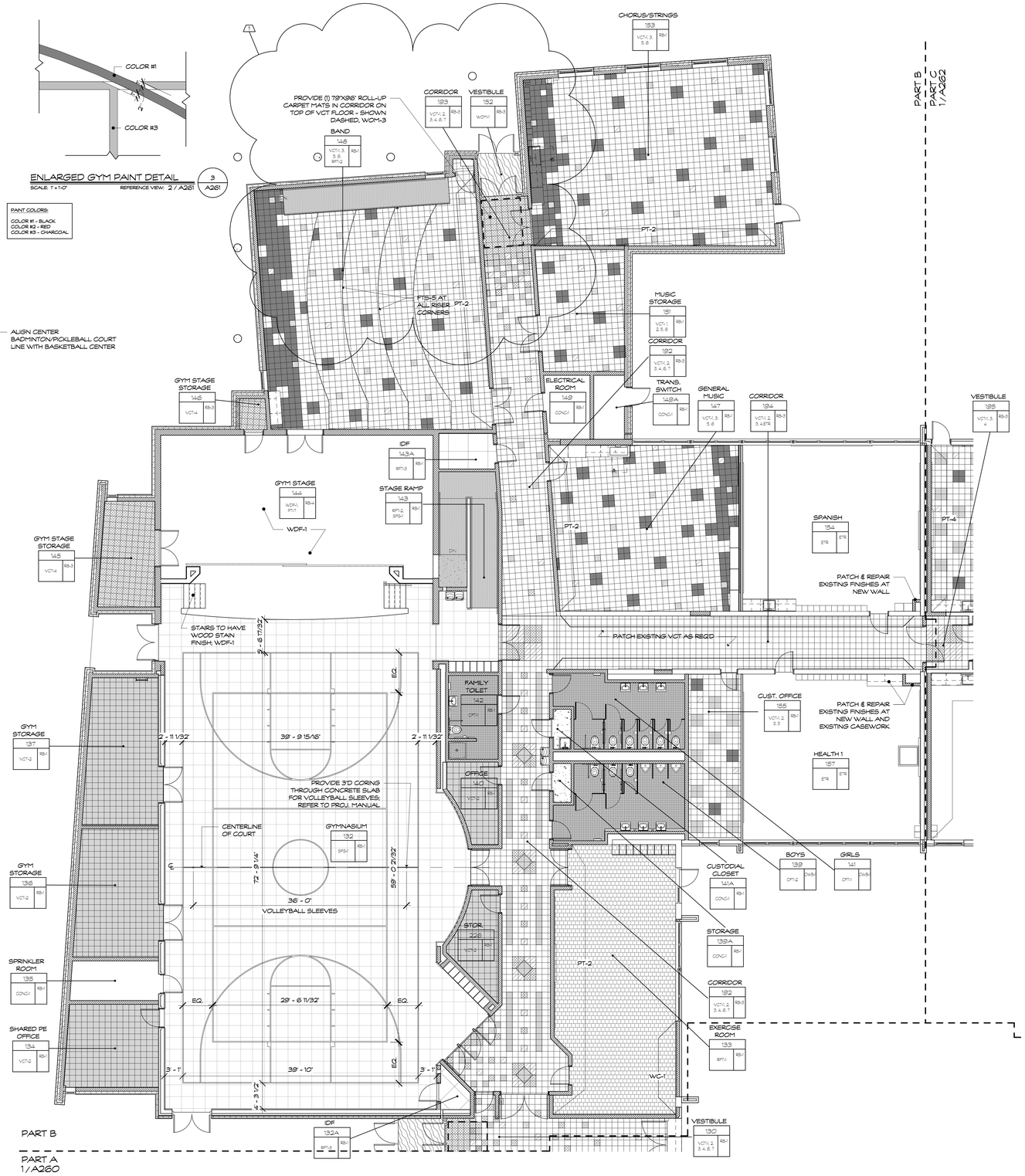


GYMNASIUM PAINT LINE DETAIL
SCALE: 1/8" = 1'-0"
NORTH
2 / A261

ENLARGED GYM PAINT DETAIL
SCALE: 1" = 1'-0"
REFERENCE VIEW: 2 / A261
3 / A261

PAINT COLORS:

COLOR #1 - BLACK
COLOR #2 - RED
COLOR #3 - CHARCOAL



Main Level Finish and Floor Pattern Plan - Part B
SCALE: 1/8" = 1'-0"
NORTH
1 / A261

FLOOR FINISH LEGEND

VCT-1	WCM-1
VCT-2	WCM-2
VCT-3	WD-1
VCT-4	EX. FLOOR TO REMAIN
VCT-5	CONC-1
VCT-6	CPT
VCT-7	CPT-1
SFS-1	CPT-2
RBF-1	RFT-1
	LVT-1

GENERAL FINISH NOTES

1. ALL WOOD STAINS TO MATCH ARCHITECTS SAMPLE
2. EXPOSED STRUCTURE TO BE PAINTED PT-1, INCLUDING BUT NOT LIMITED TO ALL DUCTWORK & PIPING, U.O.N.
3. ALL GYPSUM CEILINGS TO BE PAINTED PT-1, U.O.N.
4. PREP ALL SURFACES FOR MATERIAL TO BE APPLIED BASED ON MANUFACTURER'S GUIDELINES.
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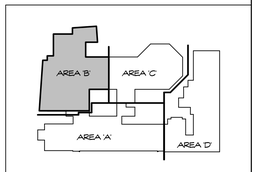
6. GYMNASIUM CEILING TO BE PAINTED PT-1, INCLUDING BUT NOT LIMITED TO ALL STRUCTURE, CEILING MOUNTED TECTUM PANELS, DUCTWORK AND PIPING.
7. ALL GUARD RAILS AND HANDRAILS TO BE PAINTED PT-3
8. ALL DOOR FRAMES TO BE PAINTED PT-3
9. IN GYMNASIUM, PROVIDE 2' GAME PAINT LINES IN THE FOLLOWING COLORS:
-BLACK GAME LINE PAINT FOR BASKETBALL COURT LINES
-RED GAME LINE PAINT FOR VOLLEYBALL COURT LINES
-CHARCOAL GAME LINE PAINT FOR BADMINTON/ PICKLEBALL COURT LINES
10. CUT AROUND ADJACENT MECHANICAL PIPING AS REQUIRED AT CASEWORK & FINISH EXPOSED CASEWORK EDGES IF APPLICABLE.
11. PROVIDE STEEL BRACKETS FOR SOLID SURFACE COUNTERTOP SUPPORT EVERY 4'-0" MAX.
12. CONFIRM ALL SPECIFIED MAGNETIC WHITEBOARD AND TACKBOARD SIZES WILL FIT ON TEACHING WALL W/ RELOCATED INTERACTIVE WHITEBOARD PRIOR TO INSTALL.



NORTH
KEY PLAN
FIRST FLOOR

Project Title:

Expansion and Alterations to:
WEST SHORE MIDDLE SCHOOL
70 Kay Avenue, Milford CT 06460

SILVER / PETRUCELLI + ASSOCIATES
Architects / Engineers / Interior Designers

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Revision:	Description:	Date:	Revised By:
1	ADDENDUM #1	11/11/2016	JET

Revision:	Description:	Date:	Revised By:

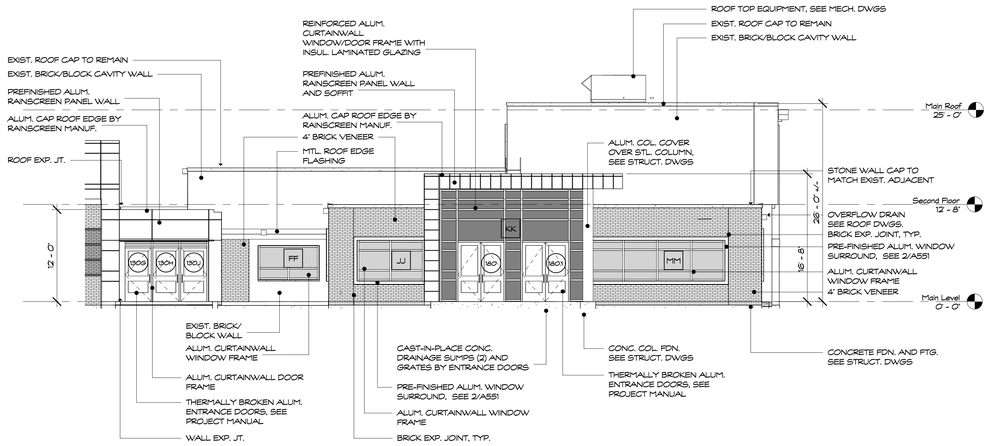
Drawing Title:

First Floor Finish & Floor Pattern Plan - Part 'B'

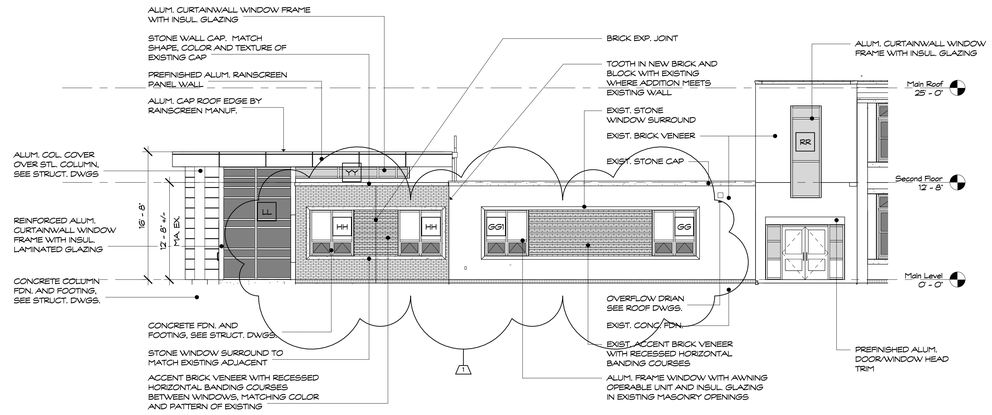
State Project Number: TMP-084-JLGB

Date: 8/18/2016
Scale: As indicated
Drawn By: Author
Project Number: 14-278

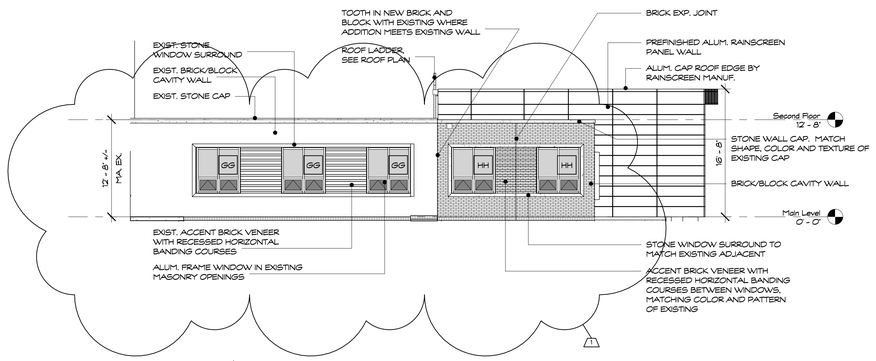
Drawing Number: A261



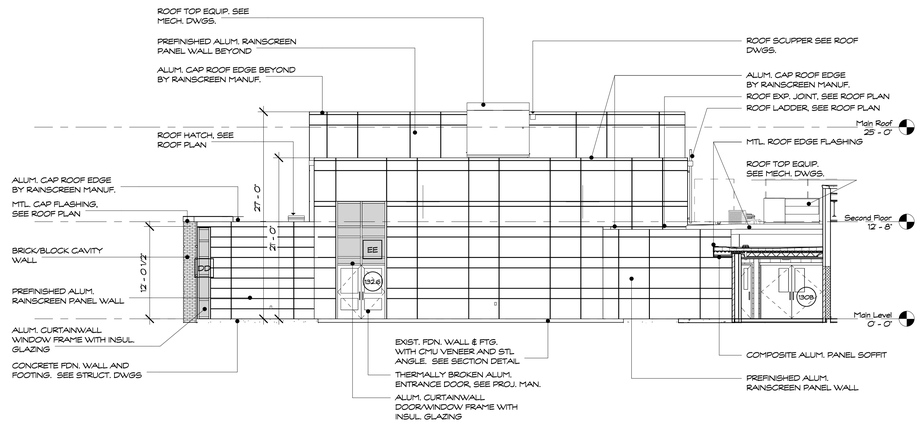
North Elevation Main Entrance
SCALE: 1/8" = 1'-0" REFERENCE VIEW: 1 / A101 — 1 / A301 — SEE DRAWING A304 FOR METAL PANEL DIMENSIONS



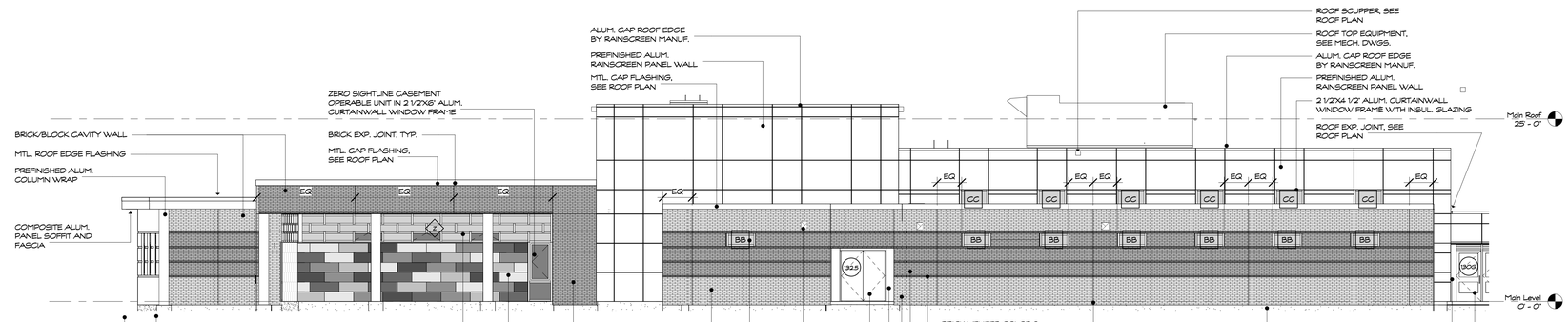
West Elevation Main Entrance & Offices
SCALE: 1/8" = 1'-0" REFERENCE VIEW: 1 / A101 — 2 / A301 — SEE DRAWING A304 FOR METAL PANEL DIMENSIONS



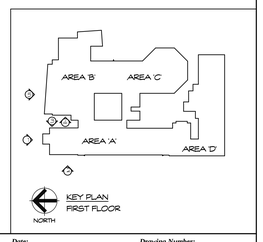
East Elevation Main Entrance & Offices
SCALE: 1/8" = 1'-0" REFERENCE VIEW: 1 / A101 — 3 / A301 — SEE DRAWING A304 FOR METAL PANEL DIMENSIONS



West Elevation Gymnasium
SCALE: 1/8" = 1'-0" REFERENCE VIEW: 1 / A101 — 4 / A301 — SEE DRAWING A304 FOR METAL PANEL DIMENSIONS



North Elevation Gymnasium, Band & Chorus Room
SCALE: 1/8" = 1'-0" REFERENCE VIEW: 1 / A101 — 5 / A301 — SEE DRAWING A304 FOR METAL PANEL DIMENSIONS



KEY PLAN
FIRST FLOOR

Project Title:

Expansion and Alterations to:

WEST SHORE MIDDLE SCHOOL

70 Kay Avenue, Milford CT 06460

SILVER / PETRUCELLI + ASSOCIATES
Architects / Engineers / Interior Designers

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silverpetrucelli.com

Revision:	Description:	Date:	Revised By:
1	ADDENDUM #1	11/1/2016	CON

Revision:	Description:	Date:	Revised By:

Drawing Title:

Partial Exterior Elevations

State Project Number: TMP-084-JLGB

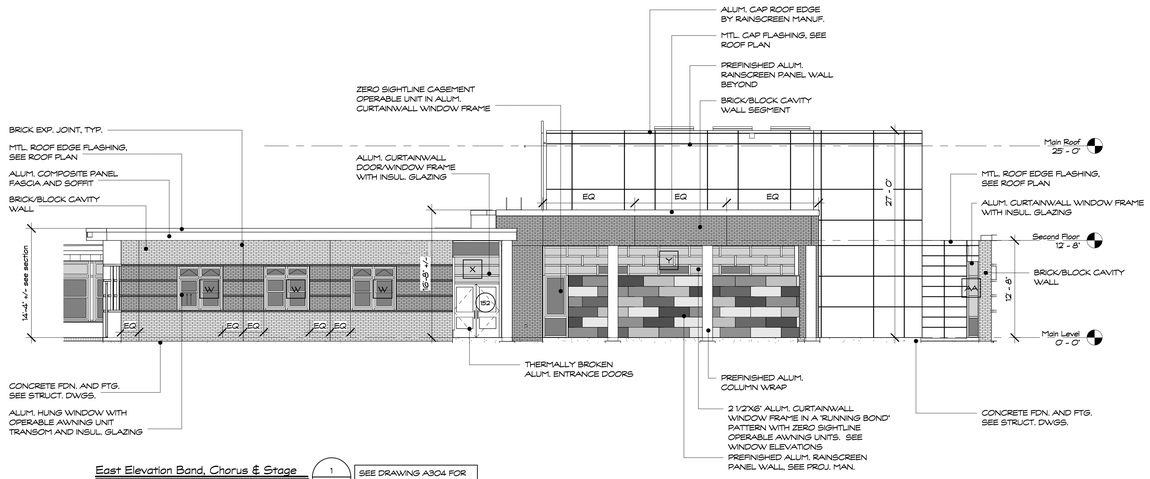
Date: 8/18/2016

Scale: 1/8" = 1'-0"

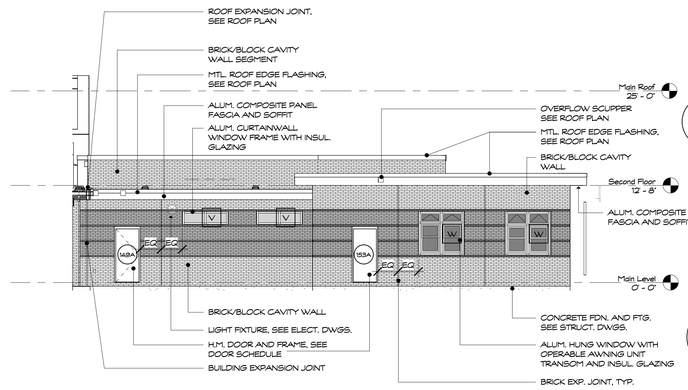
Drawn By: Author

Project Number: 14.278

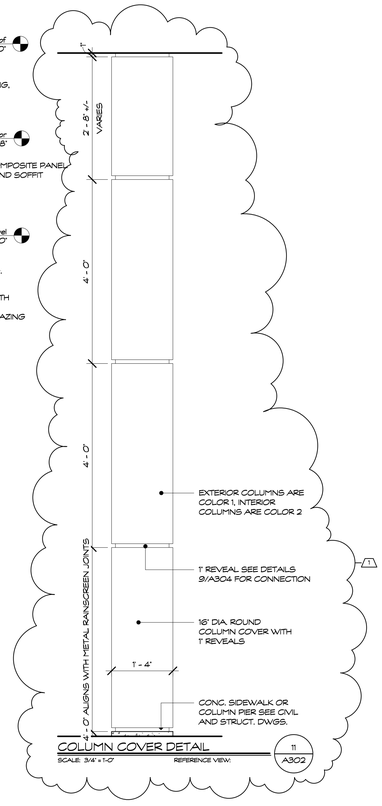
Drawing Number: A301



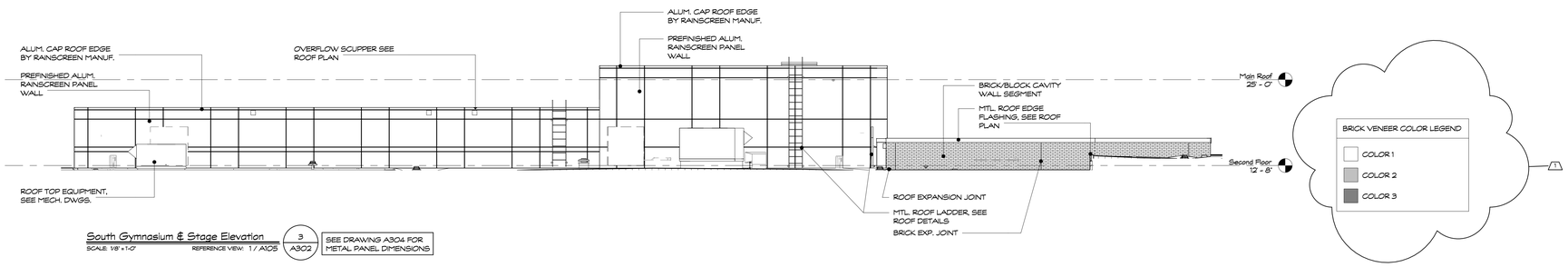
East Elevation Band, Chorus & Stage (1 / A302)
SCALE: 1/8" = 1'-0" REFERENCE VIEW: 2 / A300
SEE DRAWING A304 FOR METAL PANEL DIMENSIONS



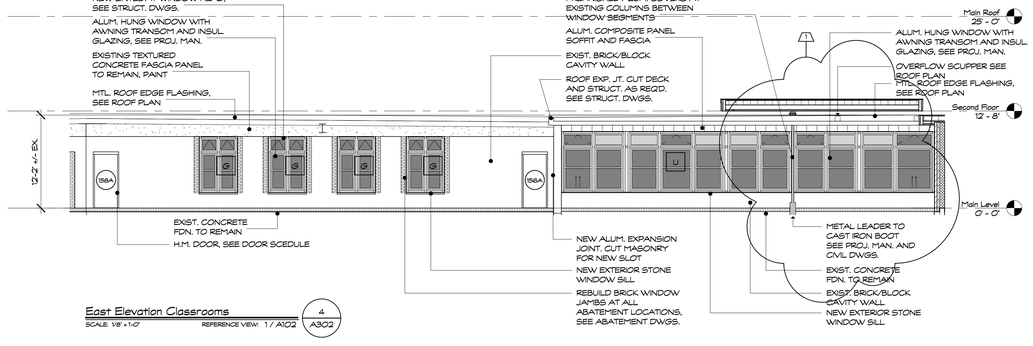
South Elevation Chorus, Storage & Electrical Room (2 / A302)
SCALE: 1/8" = 1'-0" REFERENCE VIEW: 1 / A102



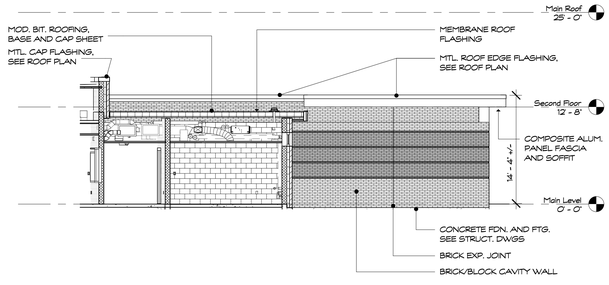
COLUMN COVER DETAIL (11 / A302)
SCALE: 3/4" = 1'-0" REFERENCE VIEW:



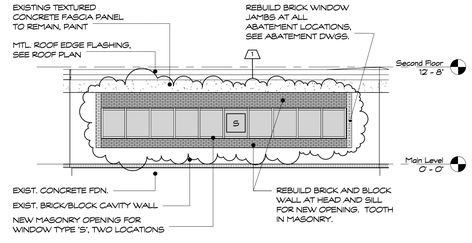
South Gymnasium & Stage Elevation (3 / A302)
SCALE: 1/8" = 1'-0" REFERENCE VIEW: 1 / A105
SEE DRAWING A304 FOR METAL PANEL DIMENSIONS



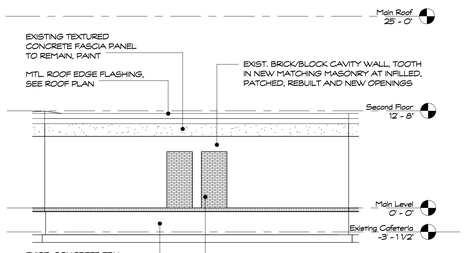
East Elevation Classrooms (4 / A302)
SCALE: 1/8" = 1'-0" REFERENCE VIEW: 1 / A102



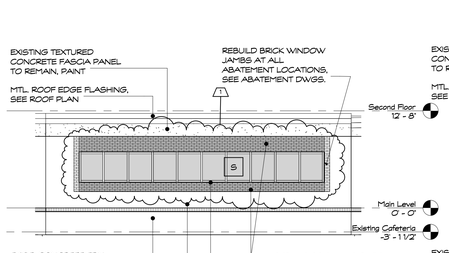
West Elevation Chorus Room (5 / A302)
SCALE: 1/8" = 1'-0" REFERENCE VIEW: 1 / A102



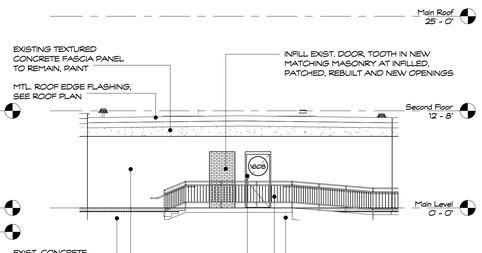
Southwest Elevation Media Center (6 / A302)
SCALE: 1/8" = 1'-0" REFERENCE VIEW: 1 / A103



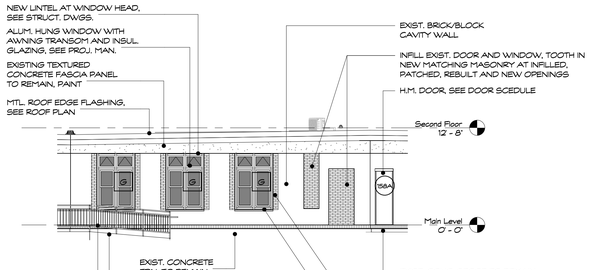
South Elevation Media Center (7 / A302)
SCALE: 1/8" = 1'-0" REFERENCE VIEW: 1 / A107



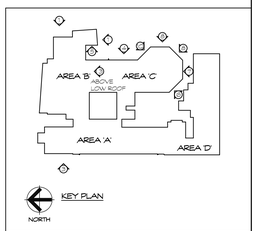
Southeast Elevation Media Center (8 / A302)
SCALE: 1/8" = 1'-0" REFERENCE VIEW: 1 / A103



East Elevation Media Center (9 / A302)
SCALE: 1/8" = 1'-0" REFERENCE VIEW: 1 / A107



Northeast Elevation Media Center (10 / A302)
SCALE: 1/8" = 1'-0" REFERENCE VIEW: 1 / A103



KEY PLAN

Project Title:
Expansion and Alterations to:
WEST SHORE MIDDLE SCHOOL
70 Kay Avenue, Milford CT 06460

SILVER / PETRUCELLI + ASSOCIATES
Architects / Engineers / Interior Designers
3190 Whitney Avenue, Hamden, CT 06518-2340
Tel. 203 230 9007 Fax. 203 230 8247
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Revision:	Description:	Date:	Revised By:
1	ADDENDUM #1	11/11/2016	CON

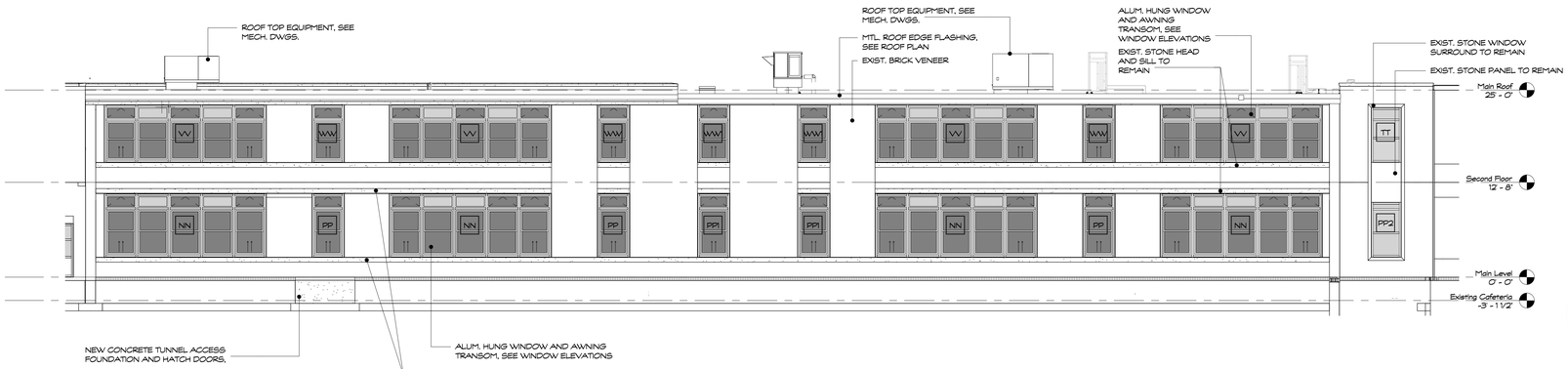
Revision:	Description:	Date:	Revised By:

Drawing Title:
Partial Exterior Elevations

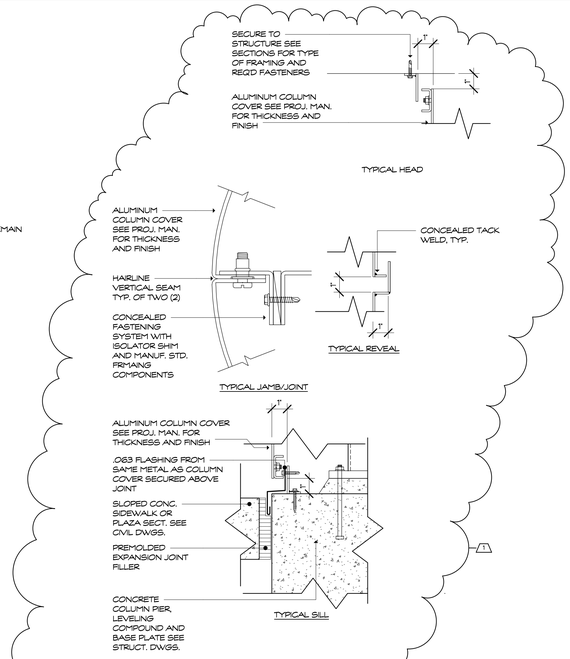
State Project Number: TMP-084-JLGB

Date: 8/18/2016
Scale: As indicated
Drawn By: Author
Project Number: 14.278

Drawing Number:
A302

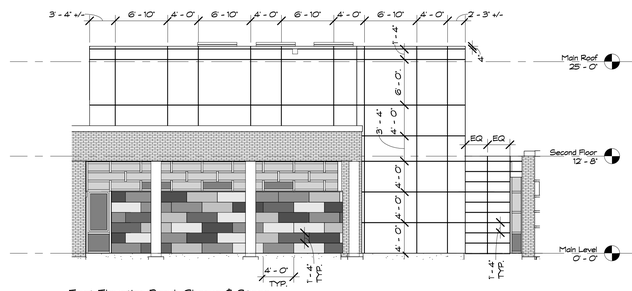


West Elevation Classrooms (1 / A304)
SCALE 1/8" = 1'-0" REFERENCE VIEW: 1 / A101



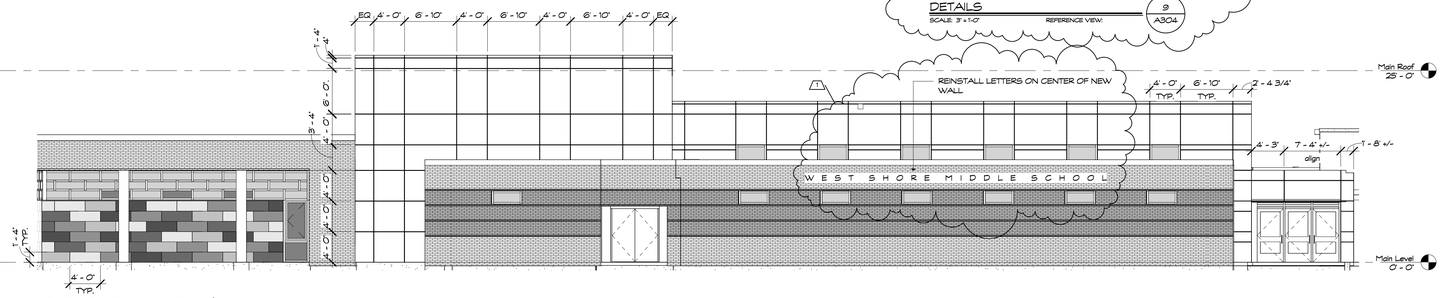
EXTERIOR COLUMN COVER DETAILS (9 / A304)
SCALE 3" = 1'-0" REFERENCE VIEW:

METAL PANEL COLOR LEGEND
COLOR 1
COLOR 2
COLOR 3
COLOR 4
COLOR 5



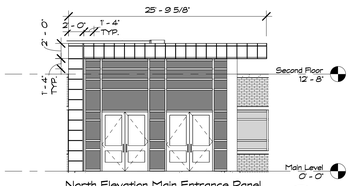
East Elevation Band, Chorus & Stage Panel Dimensions (7 / A304)
SCALE 1/8" = 1'-0" REFERENCE VIEW:

NOTE: SEE METAL PANEL COLOR LEGEND FOR PANEL COLORS

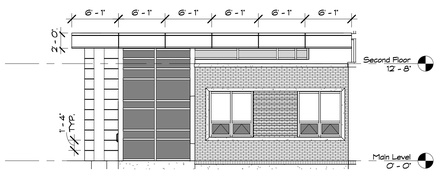


North Elevation Gymnasium, Band & Chorus Room Panel Dimensions (3 / A304)
SCALE 1/8" = 1'-0" REFERENCE VIEW: 1 / A101

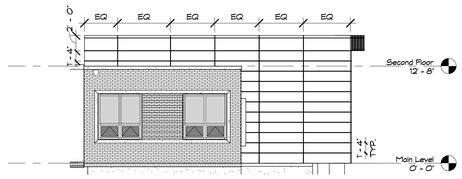
NOTE: SEE METAL PANEL COLOR LEGEND FOR PANEL COLORS



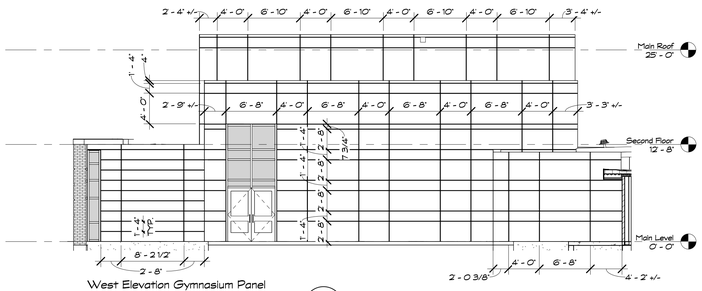
North Elevation Main Entrance Panel Dimensions (4 / A304)
SCALE 1/8" = 1'-0" REFERENCE VIEW: 1 / A101



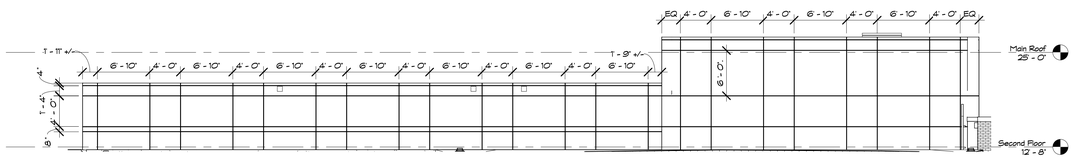
West Elevation Main Entrance & Offices Panel Dimensions (6 / A304)
SCALE 1/8" = 1'-0" REFERENCE VIEW: 1 / A101



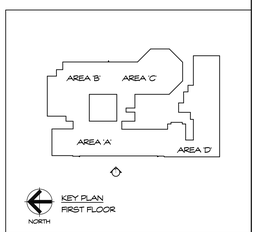
East Elevation Main Entrance & Offices Panel Dimensions (2 / A304)
SCALE 1/8" = 1'-0" REFERENCE VIEW: 1 / A101



West Elevation Gymnasium Panel Dimensions (5 / A304)
SCALE 1/8" = 1'-0" REFERENCE VIEW: 1 / A101



South Gymnasium & Stage Elevation Panel Dimensions (8 / A304)
SCALE 1/8" = 1'-0" REFERENCE VIEW: 1 / A105



Project Title:
Expansion and Alterations to:
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silverpetrucelli.com

Revision:	Description:	Date:	Revised By:
1	ADDENDUM #1	11/1/2016	CON

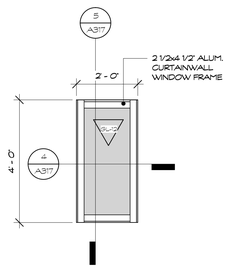
Revision:	Description:	Date:	Revised By:

Drawing Title:
Partial Exterior Elevations

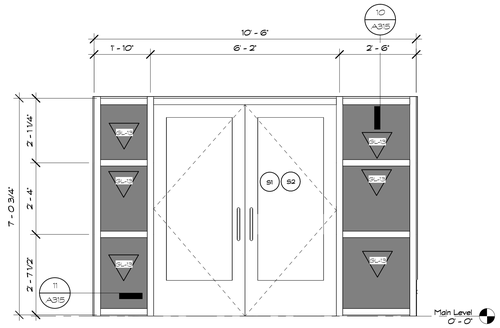
State Project Number: TMP-084-JLGB

Date: 8/18/2016
Scale: As indicated
Drawn By: Author
Project Number: 14.278

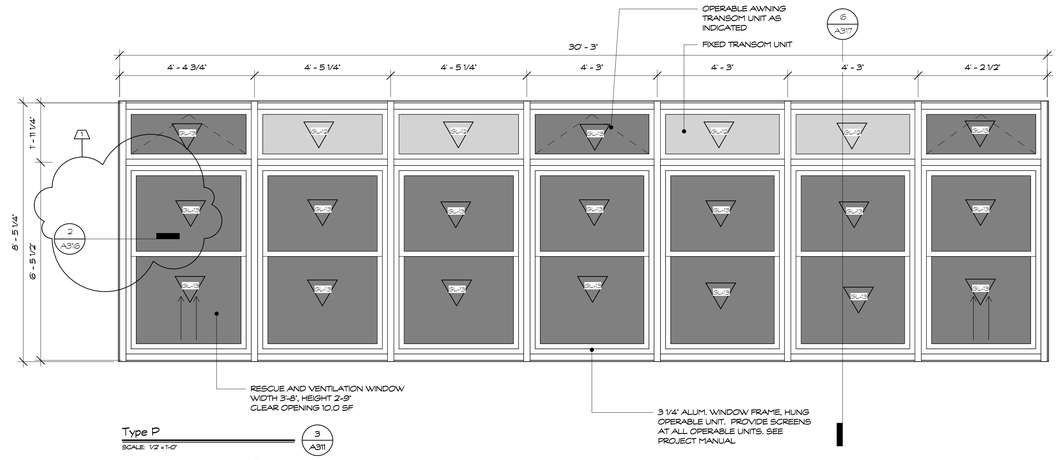
Drawing Number:
A304



Type M Tech. Ed. Storage (1 / A311)
SCALE 1/2 = 1-0"

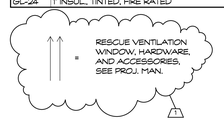


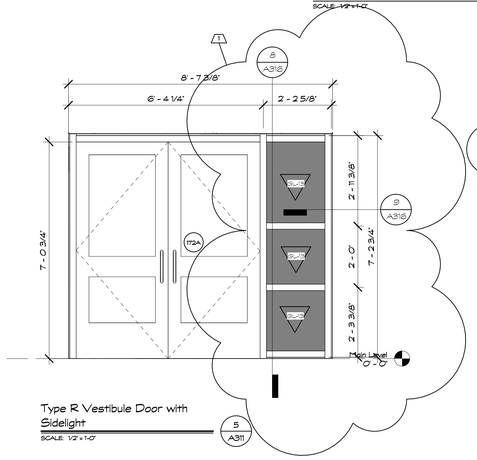
Type N Stairwell Door with Sidelights (2 / A311)
SCALE 1/2 = 1-0"



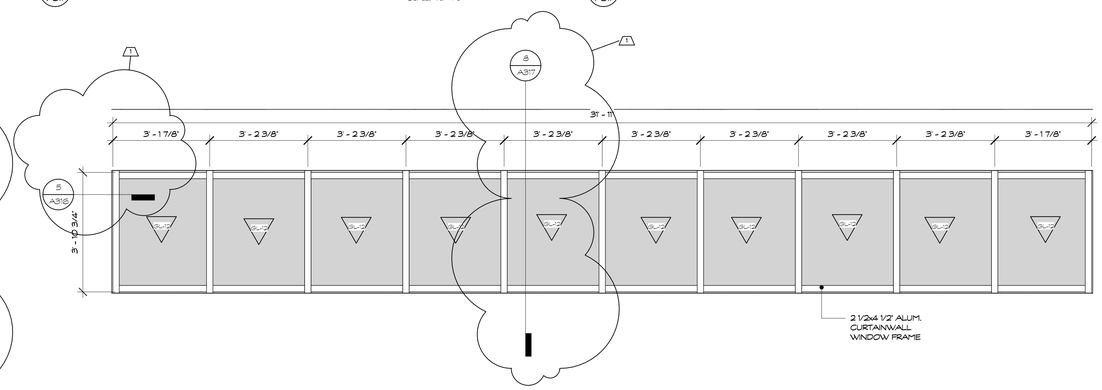
Type P (3 / A311)
SCALE 1/2 = 1-0"

GLAZING SCHEDULE		
GL-0	DECORATIVE FILM	NOT USED
GL-1	1/4" CLEAR	NOT USED
GL-2	1/4" CLEAR, TEMPERED	
GL-3	1/4" TEMPERED, FROSTED	NOT USED
GL-4	1/4" TEMPERED, PATTERNED	NOT USED
GL-5	CLEAR, LAMINATED	NOT USED
GL-6	CLEAR, LAMINATED, FIRE RATED	
GL-7	CLEAR, BALLISTIC	NOT USED
GL-8	CLEAR, BALLISTIC, FIRE RATED	
GL-9	1" INSUL., CLEAR	NOT USED
GL-10	1" INSUL., CLEAR, TEMPERED	NOT USED
GL-11	1" INSUL., TEMPERED, FROSTED	
GL-12	1" INSUL., TINTED	
GL-13	1" INSUL., TINTED, TEMPERED	
GL-14	1" INSUL., TINTED, TEMPERED, SPANDREL	
GL-15	1" INSUL., LAMINATED, FROSTED	NOT USED
GL-16	1" INSUL., ONE-WAY, LAMINATED	NOT USED
GL-17	1" INSUL., TINTED, LAMINATED	NOT USED
GL-18	INSUL., CLEAR, TEMPERED, ACOUSTICAL	NOT USED
GL-19	TINTED, LAMINATED	NOT USED
GL-20	1" INSUL., SPANDREL	NOT USED
GL-21	1" INSUL., SPANDREL, LAMINATED	
GL-22	BLAST RESISTANT, TINTED	
GL-23	INSUL., BLAST RESISTANT, TINTED	
GL-24	1" INSUL., TINTED, FIRE RATED	

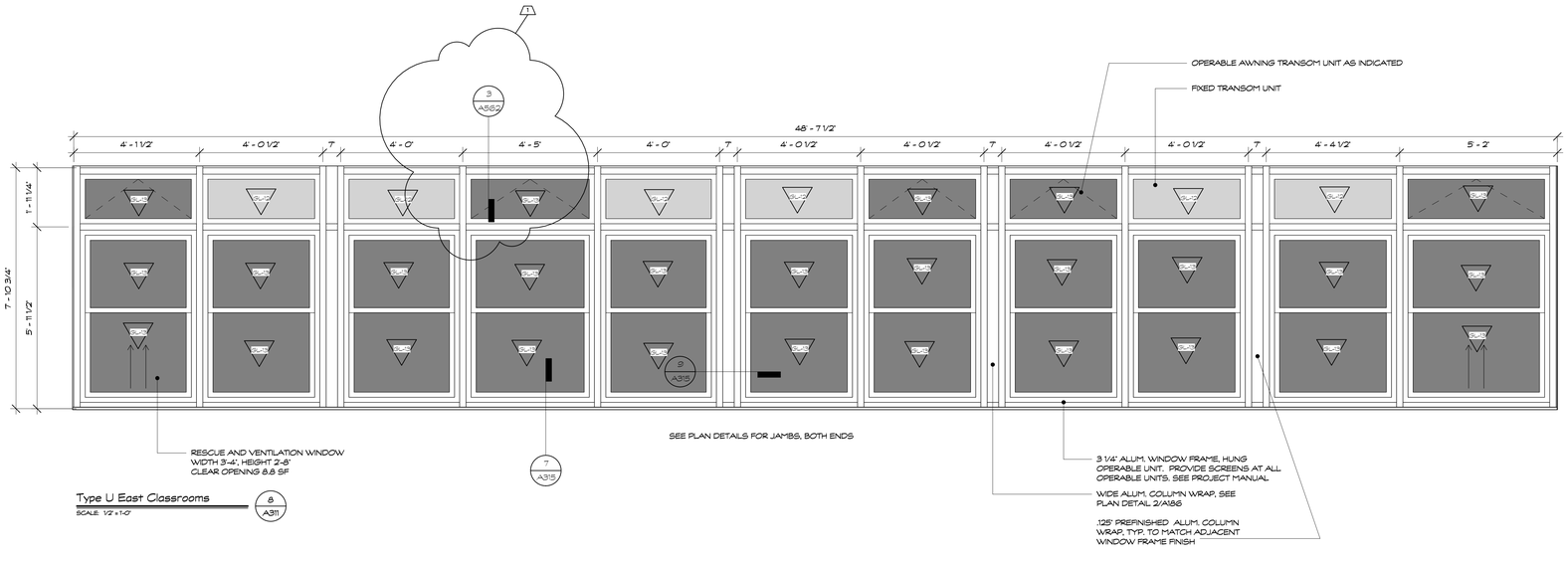




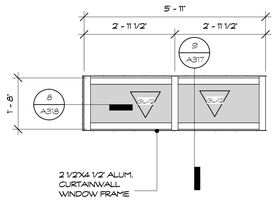
Type R Vestibule Door with Sidelight (5 / A311)
SCALE 1/2 = 1-0"



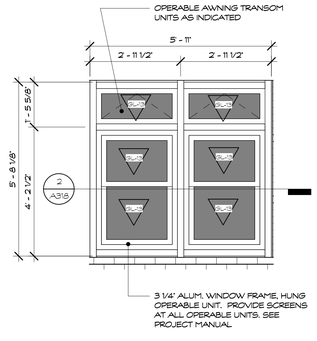
Type S Media Center (6 / A311)
SCALE 1/2 = 1-0"



Type U East Classrooms (8 / A311)
SCALE 1/2 = 1-0"



Type V Music Storage (9 / A311)
SCALE 1/2 = 1-0"



Type W Chorus (10 / A311)
SCALE 1/2 = 1-0"

Project Title:

Expansion and Alterations to:

WEST SHORE MIDDLE SCHOOL

70 Kay Avenue, Milford CT 06460

SILVER / PETRUCELLI + ASSOCIATES
Architects / Engineers / Interior Designers

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Revision:	Description:	Date:	Revised By:
1	ADDENDUM #1	11/11/2016	CON

Revision:	Description:	Date:	Revised By:

Drawing Title:

Window Elevations

State Project Number: TMP-084-JLGB

Date: 8/18/2016

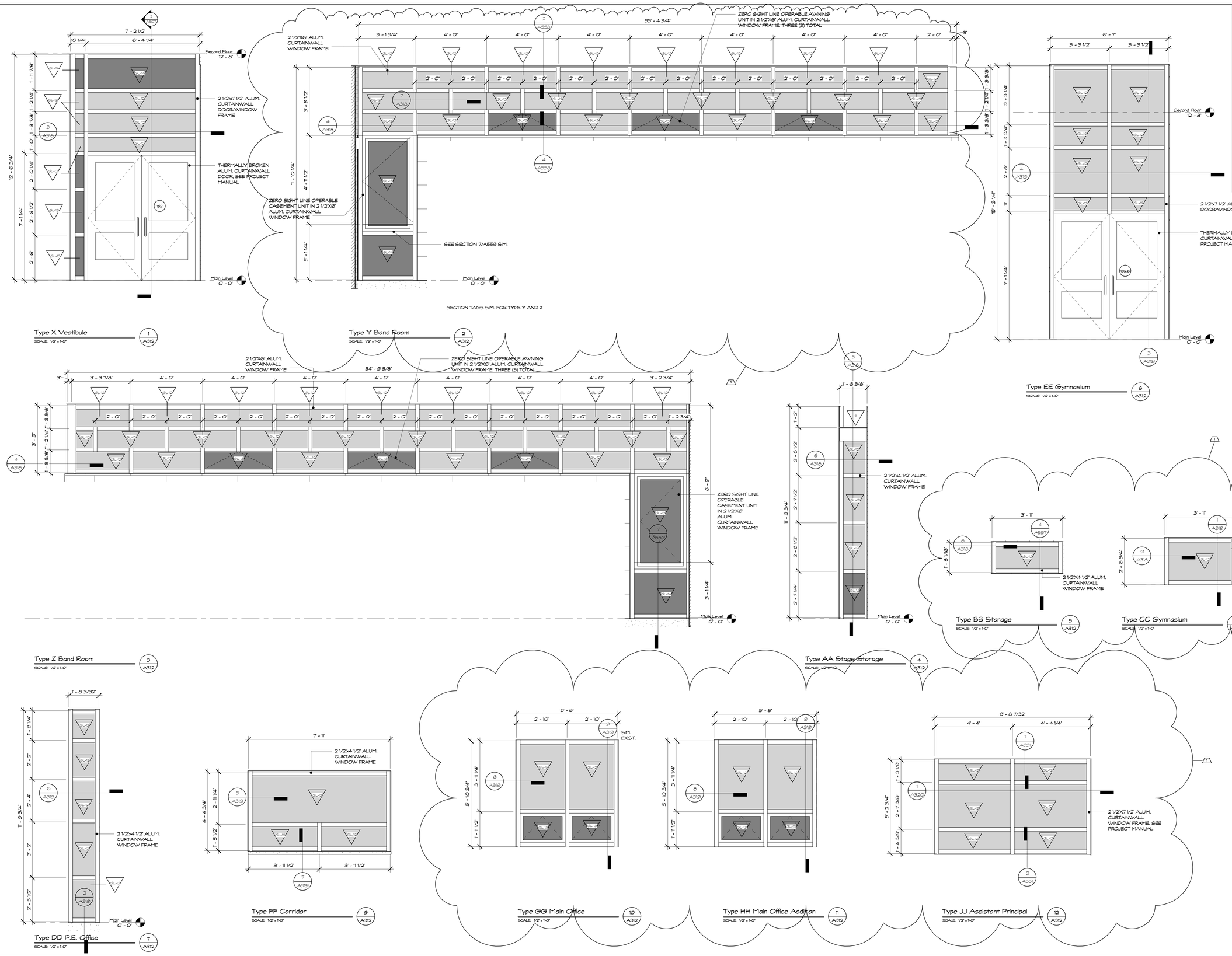
Scale: As indicated

Drawn By: Author

Project Number: 14-278

Drawing Number:

A311



GLAZING SCHEDULE

GL-0	DECORATIVE FILM	NOT USED
GL-1	1/4" CLEAR	NOT USED
GL-2	1/4" CLEAR, TEMPERED	
GL-3	1/4" TEMPERED, FROSTED	NOT USED
GL-4	1/4" TEMPERED, PATTERNED	NOT USED
GL-5	CLEAR, LAMINATED	NOT USED
GL-6	CLEAR, LAMINATED, FIRE RATED	
GL-7	CLEAR, BALLISTIC	NOT USED
GL-8	CLEAR, BALLISTIC, FIRE RATED	
GL-9	1" INSUL., CLEAR	NOT USED
GL-10	1" INSUL., CLEAR, TEMPERED	NOT USED
GL-11	1" INSUL., TEMPERED, FROSTED	
GL-12	1" INSUL., TINTED	
GL-13	1" INSUL., TINTED, TEMPERED	
GL-14	1" INSUL., TINTED, TEMPERED, SPANDREL	
GL-15	1" INSUL., LAMINATED, FROSTED	NOT USED
GL-16	1" INSUL., ONE-WAY, LAMINATED	NOT USED
GL-17	1" INSUL., TINTED, LAMINATED	NOT USED
GL-18	INSUL., CLEAR, TEMPERED, ACOUSTICAL	NOT USED
GL-19	TINTED, LAMINATED	NOT USED
GL-20	1" INSUL., SPANDREL	NOT USED
GL-21	1" INSUL., SPANDREL, LAMINATED	
GL-22	BLAST RESISTANT, TINTED	
GL-23	INSUL., BLAST RESISTANT, TINTED	
GL-24	1" INSUL., TINTED, FIRE RATED	

Project Title:

Expansion and Alterations to:

WEST SHORE MIDDLE SCHOOL

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Revision:	Description:	Date:	Revised By:
1	ADDENDUM #1	11/1/2016	PEJ

Drawing Title:

Window Elevations

State Project Number: TMP-084-JLGB

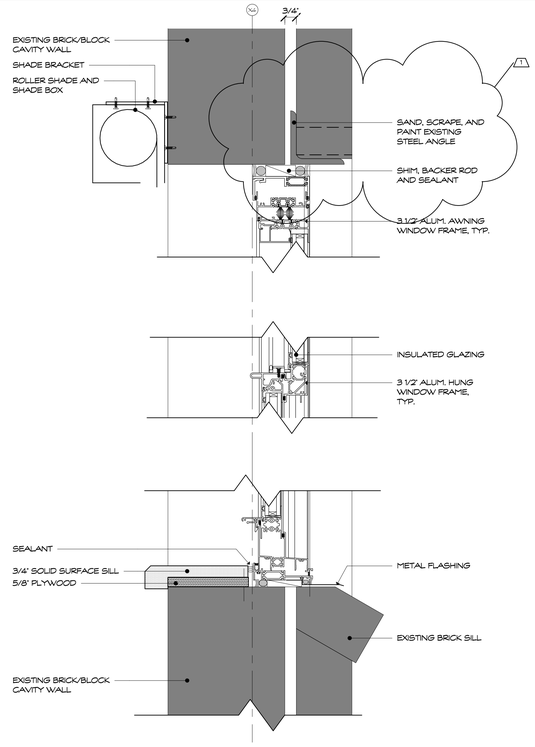
Date: 8-18-2016

Scale: 1/2" = 1'-0"

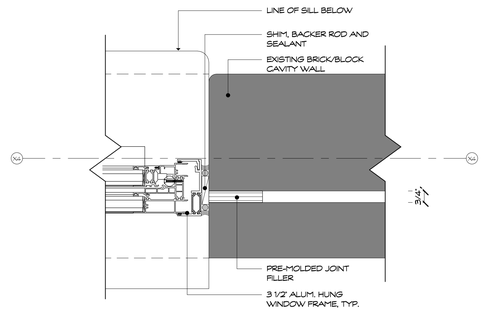
Drawn By: Author

Project Number: 14-278

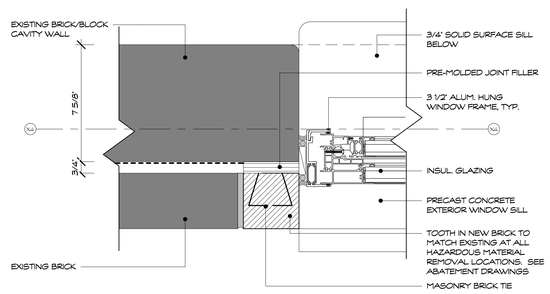
Drawing Number: A312



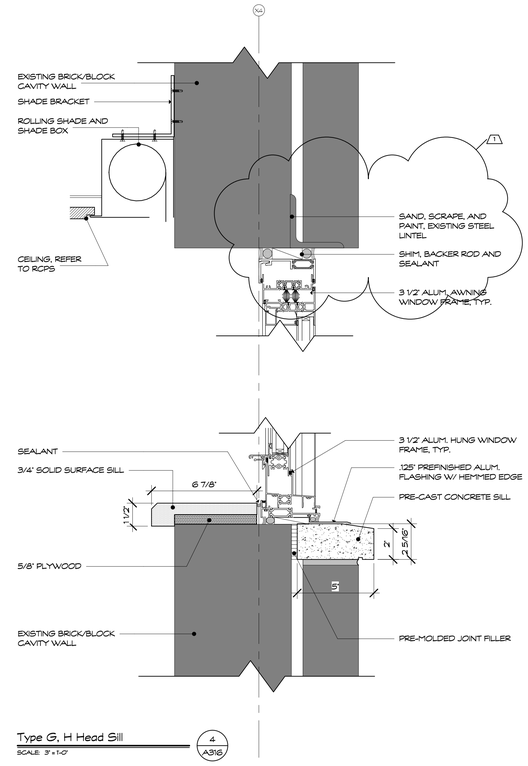
Type E Head Sill — 1 / A316
SCALE 3" = 1'-0"



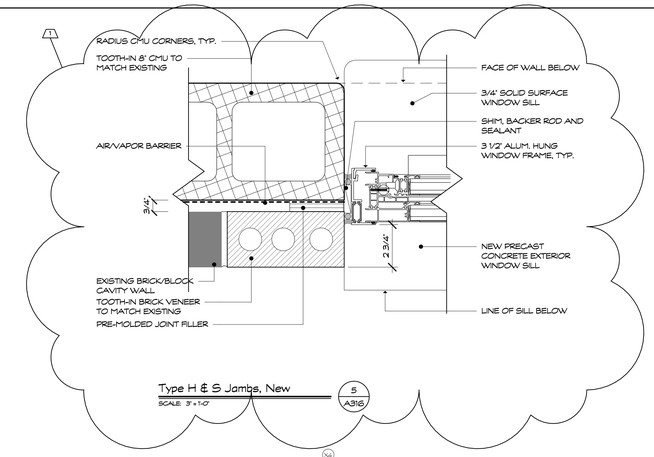
Type E Jambs — 2 / A316
SCALE 3" = 1'-0"



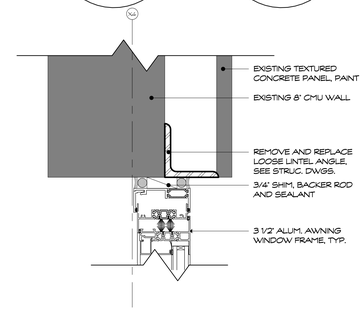
Type G, H Jambs — 3 / A316
SCALE 3" = 1'-0"



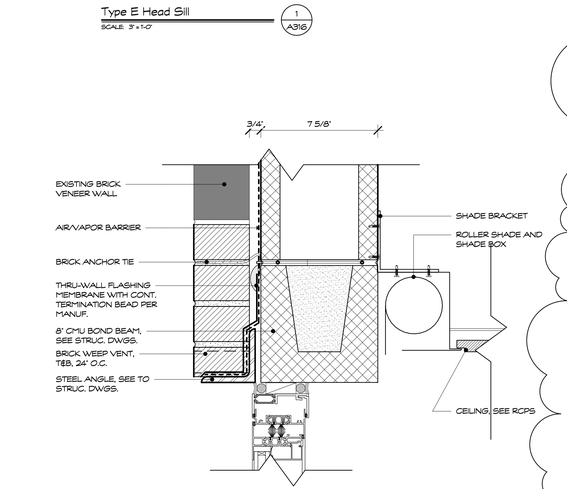
Type G, H Head Sill — 4 / A316
SCALE 3" = 1'-0"

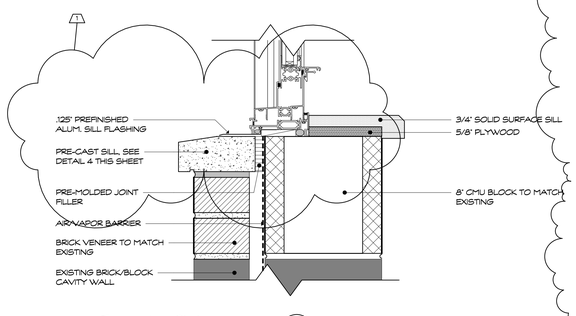


Type H & S Jambs, New — 5 / A316
SCALE 3" = 1'-0"

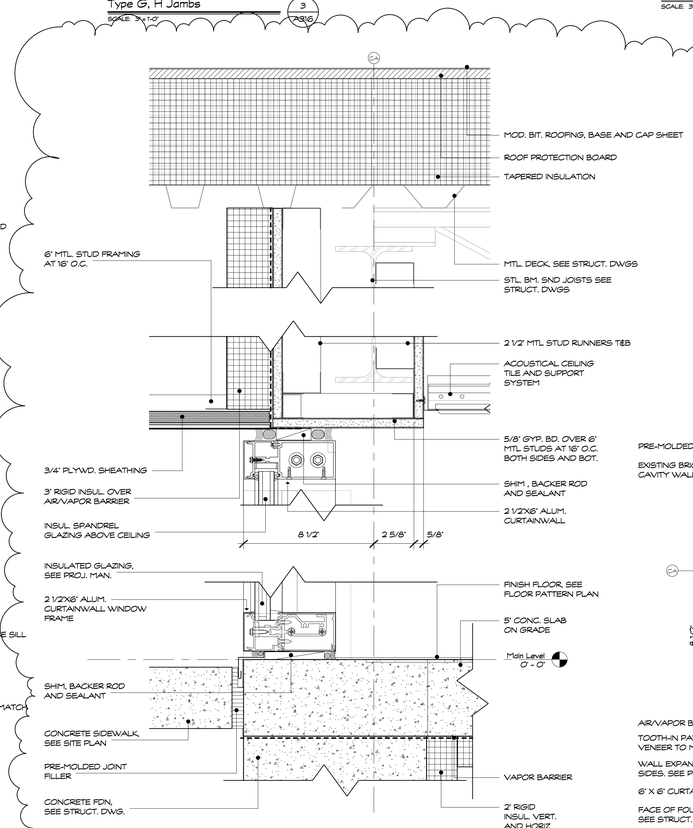


Type H1 Head — 6 / A316
SCALE 3" = 1'-0"

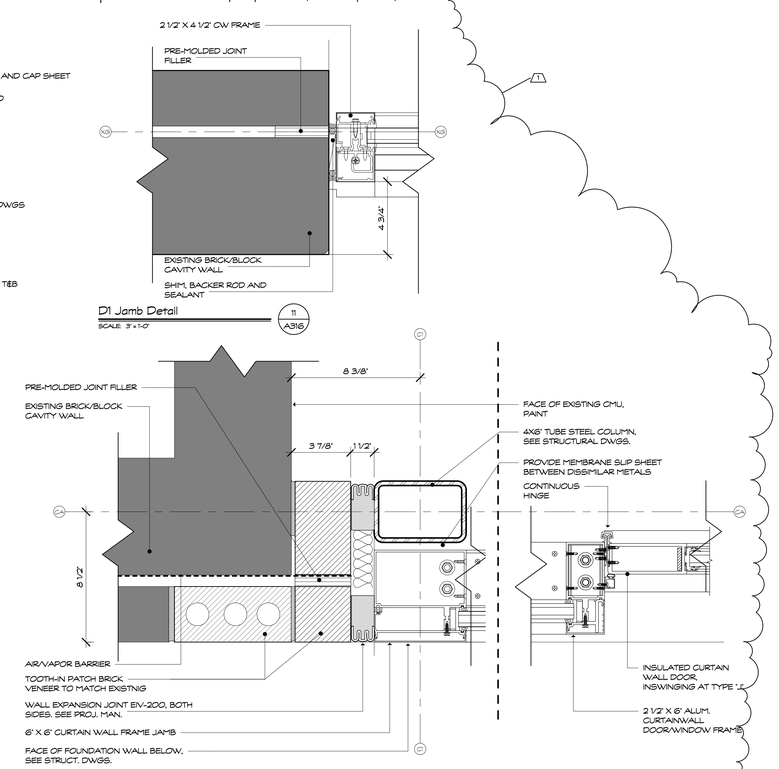




Type H Head Sill, New — 7 / A316
SCALE 3" = 1'-0"

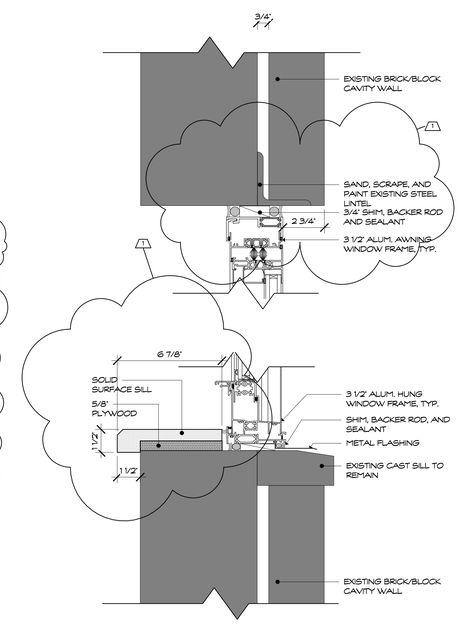


Type J Head Sill — 8 / A316
SCALE 3" = 1'-0"



D1 Jamb Detail — 11 / A316
SCALE 3" = 1'-0"

Type J and R Jamb — 9 / A316
SCALE 3" = 1'-0"



Type K Head Sill — 10 / A316
SCALE 3" = 1'-0"

Project Title:

Expansion and Alterations to:

WEST SHORE MIDDLE SCHOOL

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Revision:	Description:	Date:	Revised By:
1	ADDENDUM #1	11/11/2016	CON

Revision:	Description:	Date:	Revised By:

Drawing Title:

Window Details

State Project Number: TMP-084-JLGB

Date: 8-18-2016

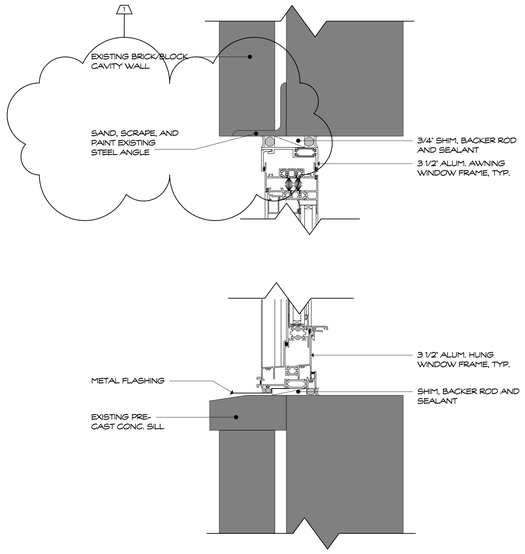
Scale: 3" = 1'-0"

Drawn By: Author

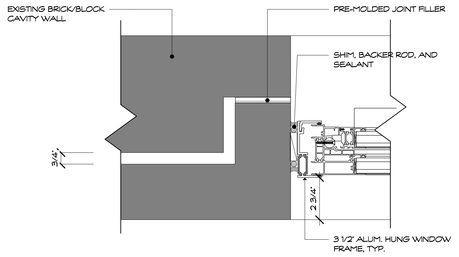
Project Number: 14.278

Drawing Number:

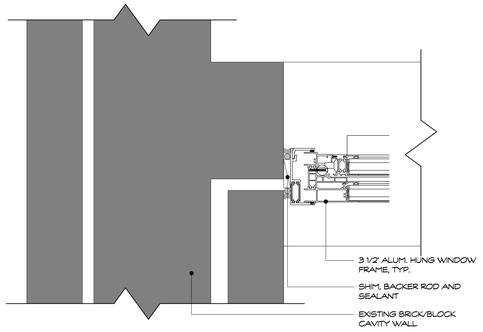
A316



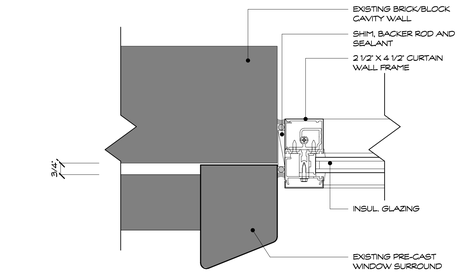
Type L Head Sill — 1 / A317
SCALE: 3" = 1'-0"



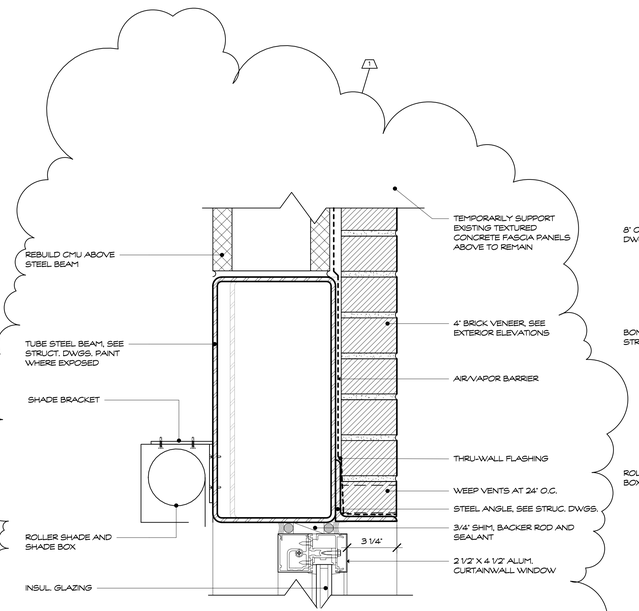
Type K Jambs — 2 / A317
SCALE: 3" = 1'-0"

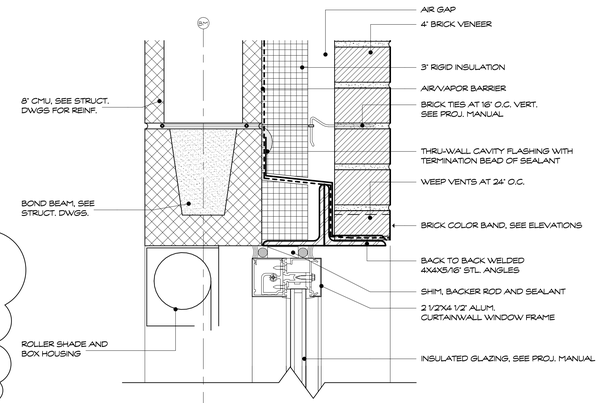


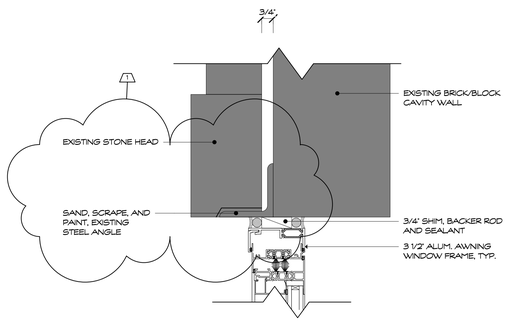
Type L Jambs — 3 / A317
SCALE: 3" = 1'-0"

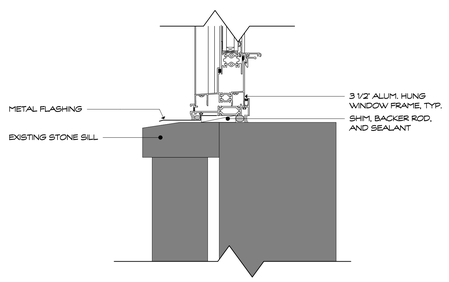


Type M Jambs — 4 / A317
SCALE: 3" = 1'-0"

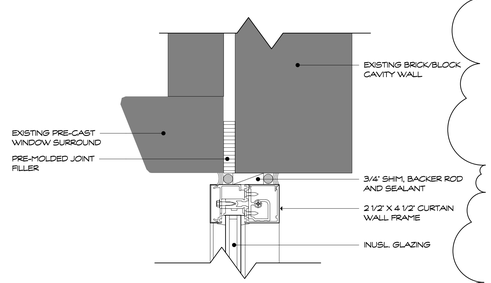


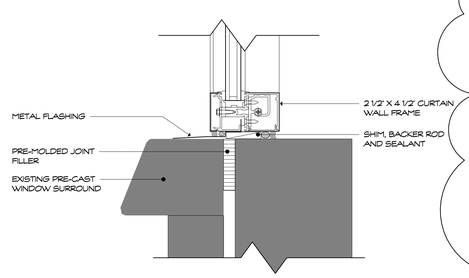




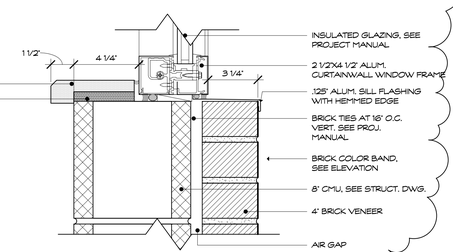


Type P Head Sill — 6 / A317
SCALE: 3" = 1'-0"

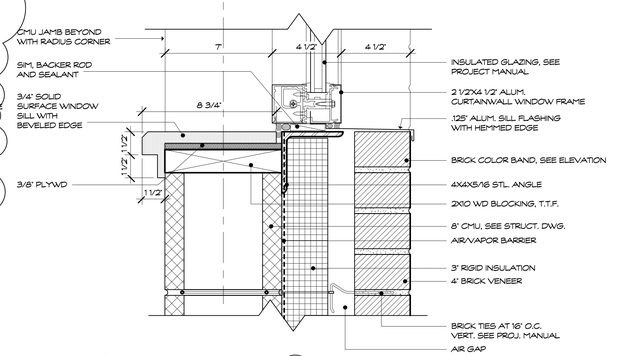




Type M Head Sill — 5 / A317
SCALE: 3" = 1'-0"



Type S Head Sill — 8 / A317
SCALE: 3" = 1'-0"



Type V & BB Head Sill — 9 / A317
SCALE: 3" = 1'-0"

Project Title:

Expansion and Alterations to:

WEST SHORE MIDDLE SCHOOL

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Revision:	Description:	Date:	Revised By:
1	ADDENDUM #1	11/11/2016	CON

Revision:	Description:	Date:	Revised By:

Drawing Title:

Window Details

State Project Number: TMP-084-JLGB

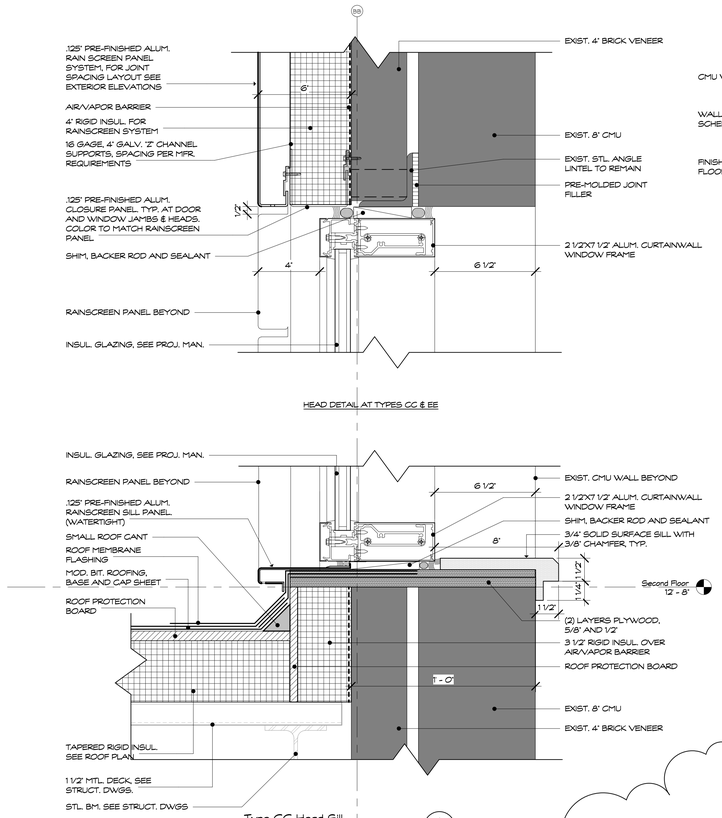
Date: 8-18-2016

Scale: 3" = 1'-0"

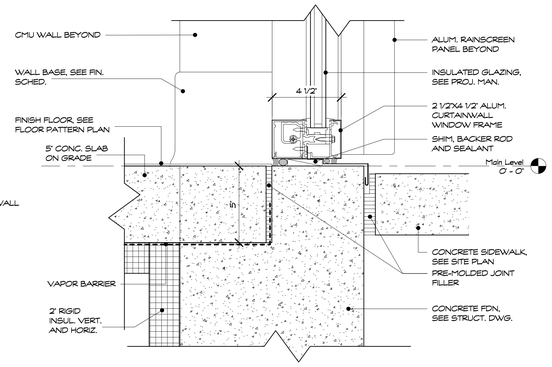
Drawn By: Author

Project Number: 14.278

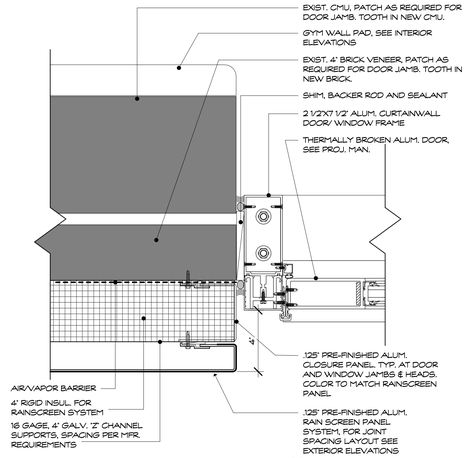
Drawing Number: A317



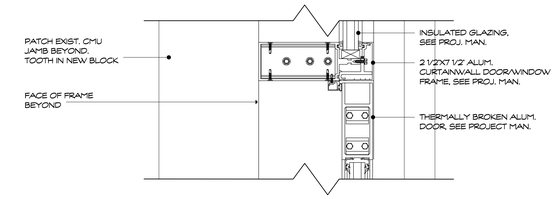
HEAD DETAIL AT TYPES CC & EE

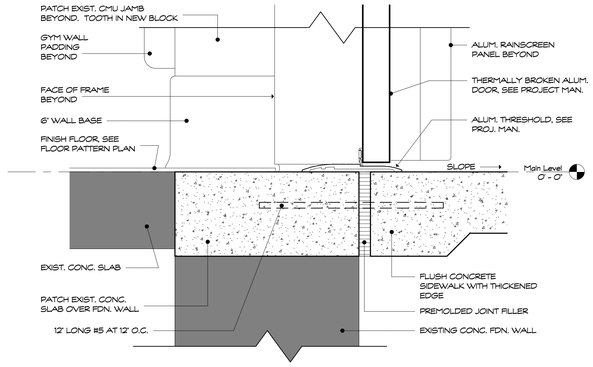


Type DD Sill — SCALE 3" = 1'-0" — 2 / A319

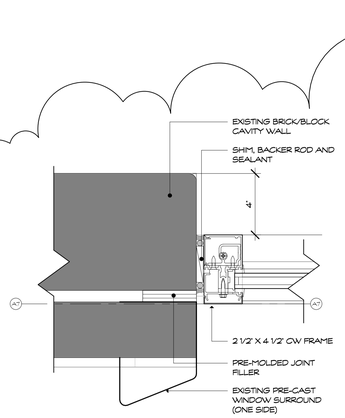


Type EE Jambs — SCALE 3" = 1'-0" — 4 / A319

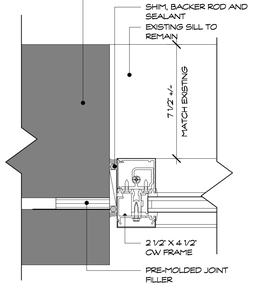




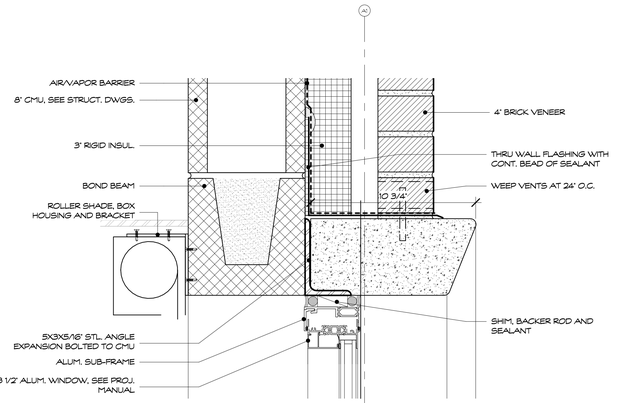
Type CC Head Sill — SCALE 3" = 1'-0" — 1 / A319



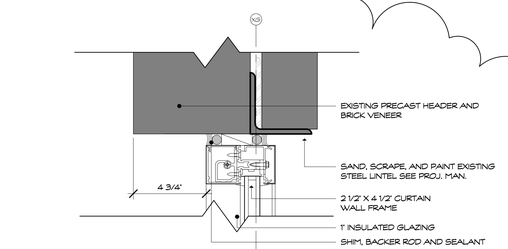
Type GG/GG1 Jambs — SCALE 3" = 1'-0" — 6 / A319



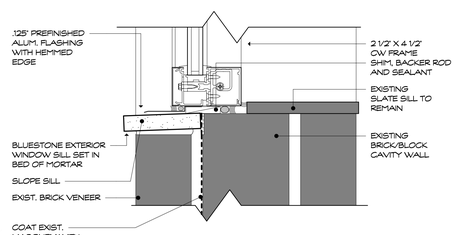
Type FF Jambs — SCALE 3" = 1'-0" — 5 / A319



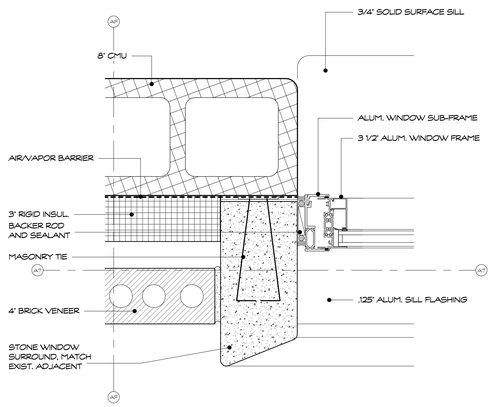
Type HH Head Sill — SCALE 3" = 1'-0" — 9 / A319



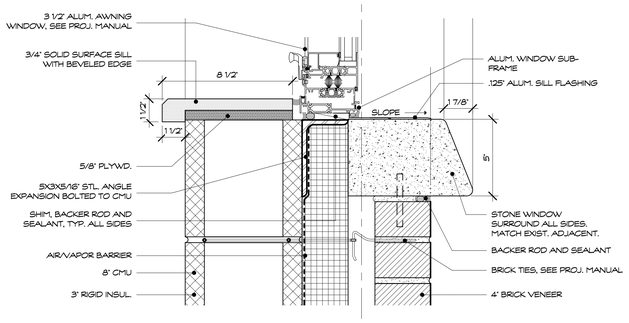
Type EE Sill — SCALE 3" = 1'-0" — 3 / A319



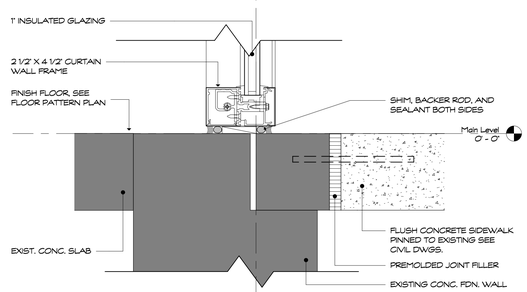
Type FF Sill — SCALE 3" = 1'-0" — 7 / A319



Type HH Jambs — SCALE 3" = 1'-0" — 8 / A319



Type HH Head Sill — SCALE 3" = 1'-0" — 9 / A319



D1 Head/Sill Detail — SCALE 3" = 1'-0" — 10 / A319

Project Title:

Expansion and Alterations to:

WEST SHORE MIDDLE SCHOOL

70 Kay Avenue, Milford CT 06460

SILVER / PETRUCELLI + ASSOCIATES
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Revision:	Description:	Date:	Revised By:
1	ADDENDUM #1	11/11/2016	CON

Revision:	Description:	Date:	Revised By:

Drawing Title:

Window Details

State Project Number: TMP-084-JLGB

Date: 8/18/2016

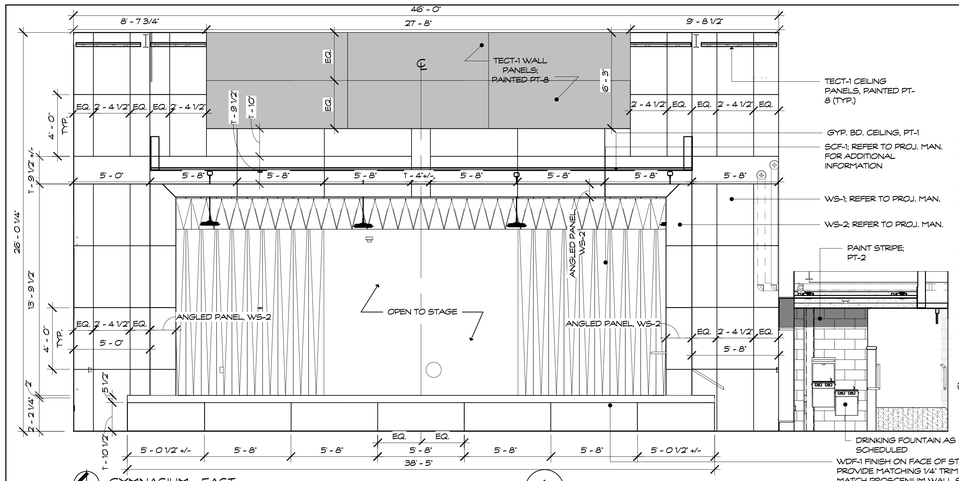
Scale: 3" = 1'-0"

Drawn By: Author

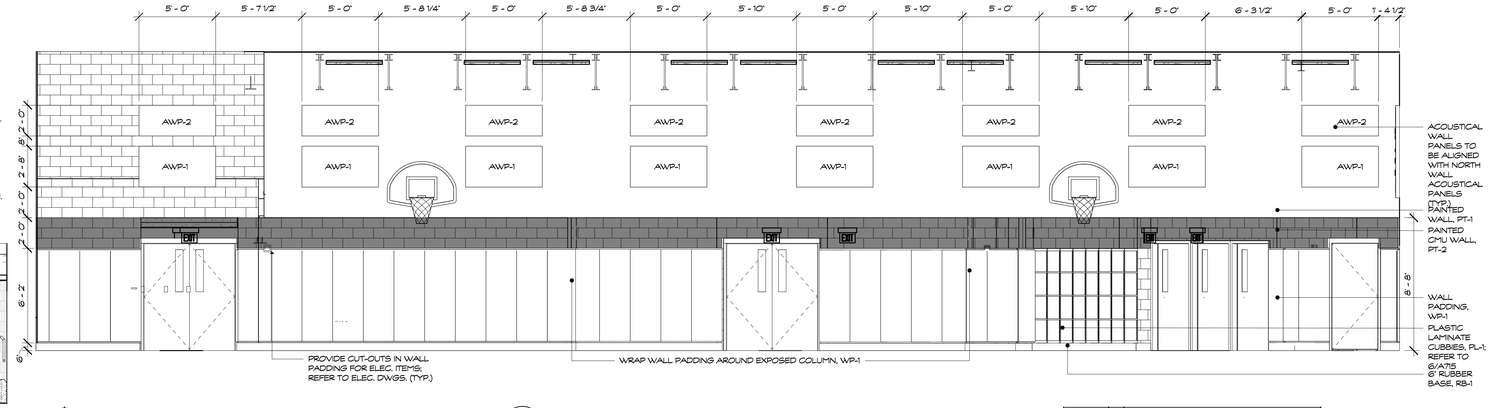
Project Number: 14.278

Drawing Number:

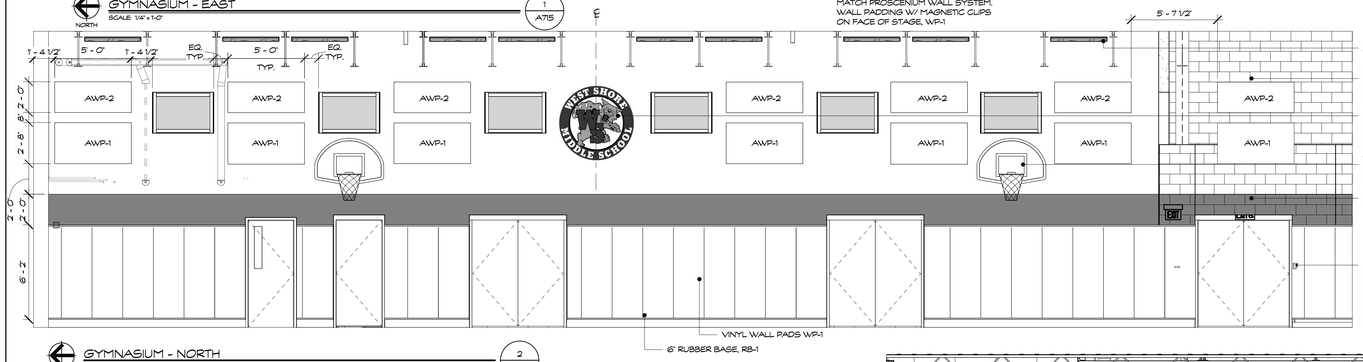
A319



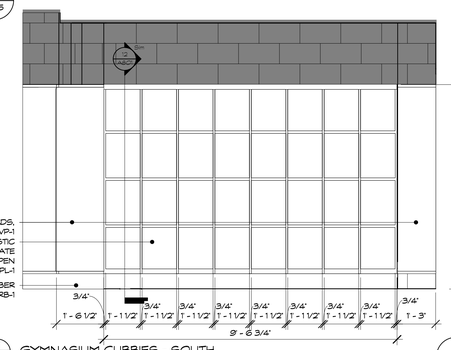
GYMNASIUM - EAST (1 / A715)
SCALE: 1/4" = 1'-0"



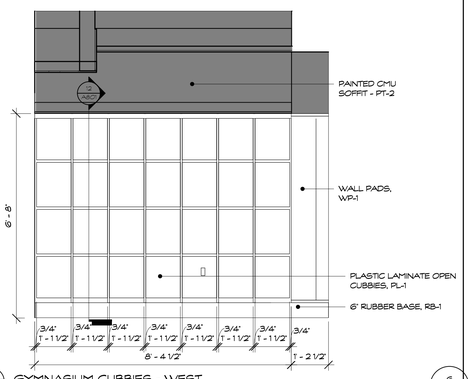
GYMNASIUM - SOUTH (4 / A715)
SCALE: 1/4" = 1'-0"



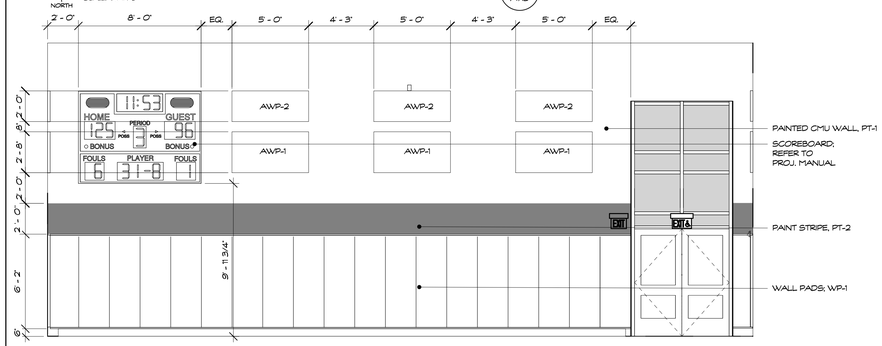
GYMNASIUM - NORTH (2 / A715)
SCALE: 1/4" = 1'-0"



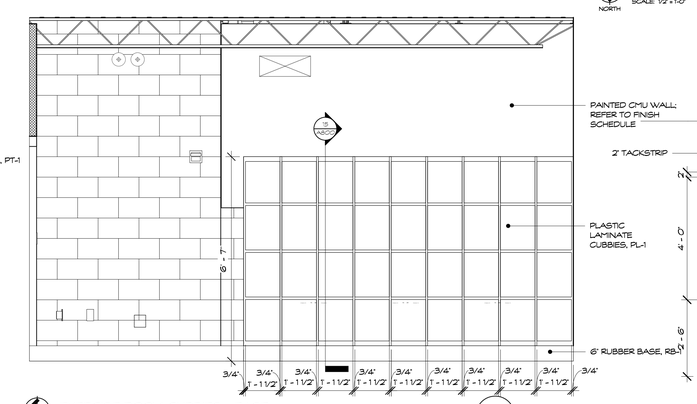
GYMNASIUM CUBBIES - SOUTH (5 / A715)
SCALE: 1/2" = 1'-0"



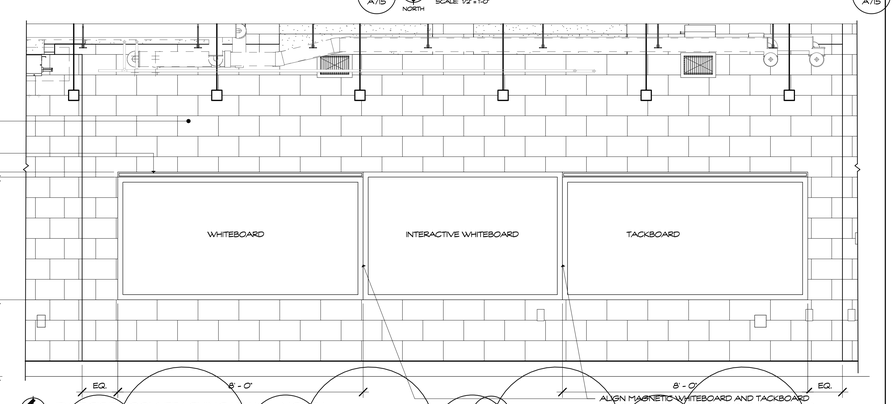
GYMNASIUM CUBBIES - WEST (6 / A715)
SCALE: 1/2" = 1'-0"



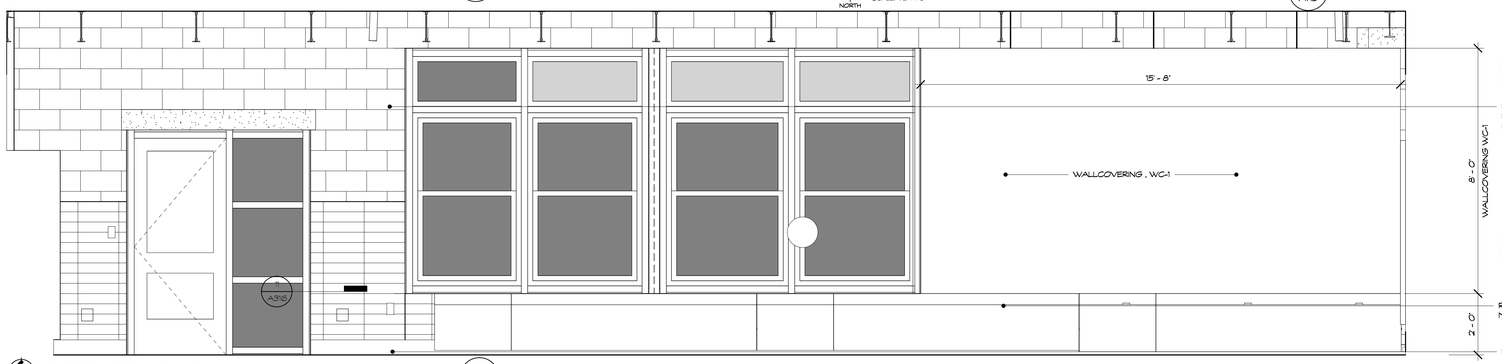
GYMNASIUM - WEST (3 / A715)
SCALE: 1/4" = 1'-0"



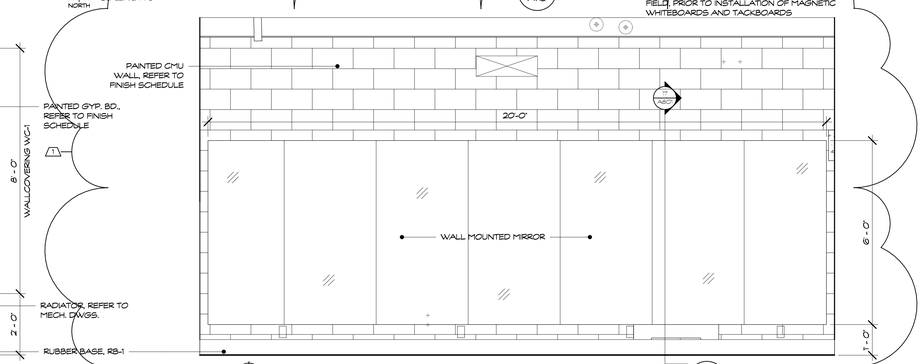
EXERCISE ROOM CUBBIES - EAST (7 / A715)
SCALE: 1/2" = 1'-0"



EXERCISE ROOM TEACHING WALL - NORTH (10 / A715)
SCALE: 1/2" = 1'-0"



EXERCISE ROOM - SOUTH (9 / A715)
SCALE: 1/2" = 1'-0"



EXERCISE ROOM - WEST (8 / A715)
SCALE: 1/2" = 1'-0"

Project Title:
Expansion and Alterations to:
WEST SHORE MIDDLE SCHOOL
70 Kay Avenue, Milford CT 06460

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3190 Whitney Avenue, Hamden, CT 06518-2340
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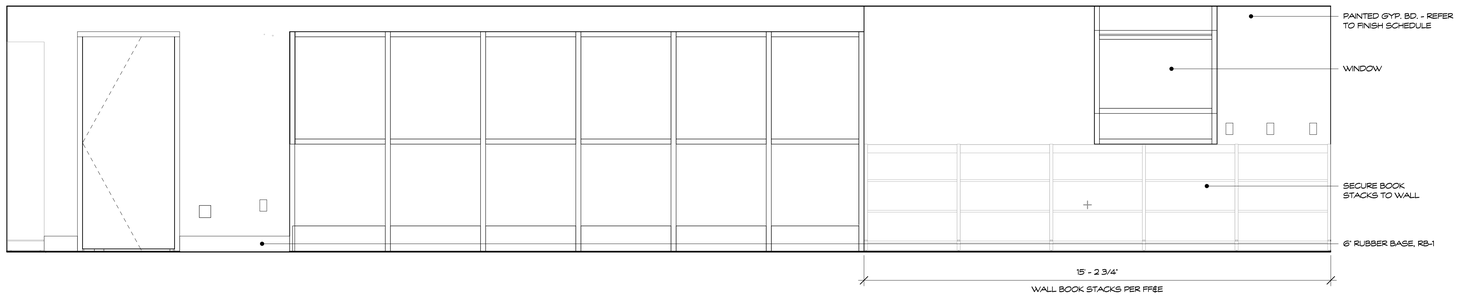
Revision:	Description:	Date:	Revised By:
1	ADDENDUM #1	11/1/2016	JET

Drawing Title:
Interior Elevations - Part 'B'
Gymnasium

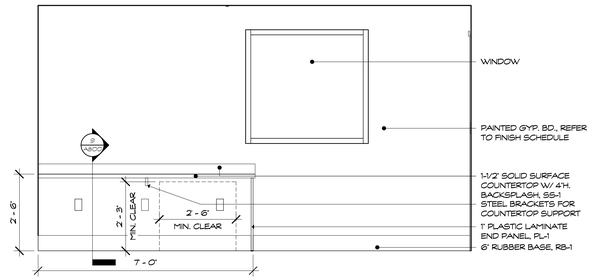
State Project Number: TMP-084-JLGB

Date: 8/26/2016
Scale: As indicated
Drawn By: JET
Project Number: 14.278

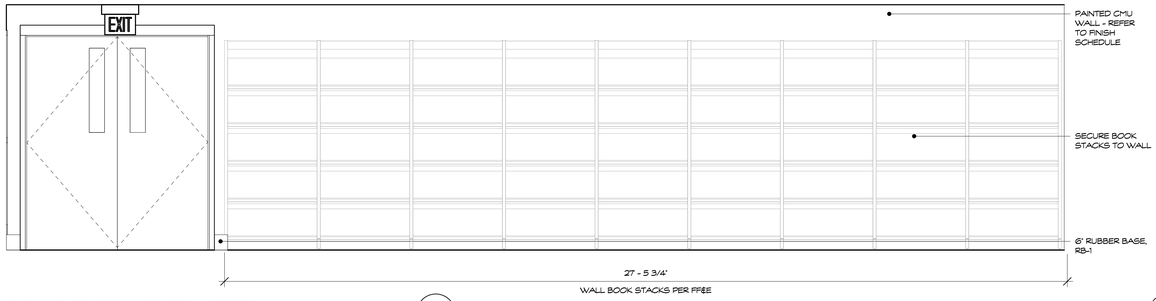
Drawing Number:
A715



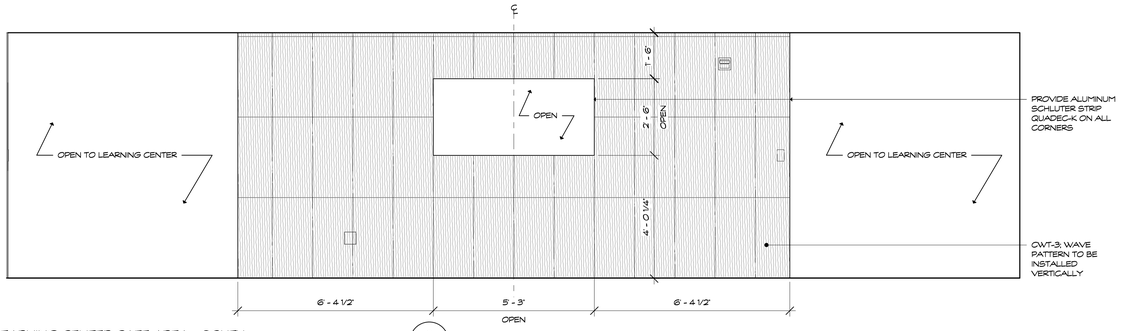
NORTH LEARNING CENTER CAFE AREA - EAST (1 / A719)
SCALE: 1/2" = 1'-0"



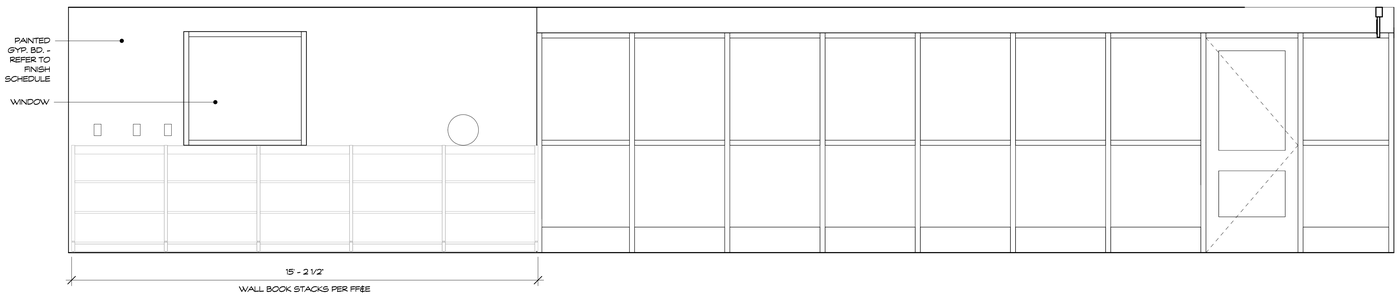
NORTH GREEN SCREEN/EDITING ROOM - EAST (5 / A719)
SCALE: 1/2" = 1'-0"



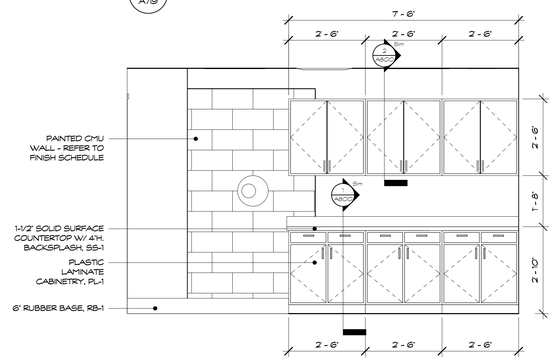
NORTH LEARNING CENTER CAFE AREA - NORTH (2 / A719)
SCALE: 1/2" = 1'-0"



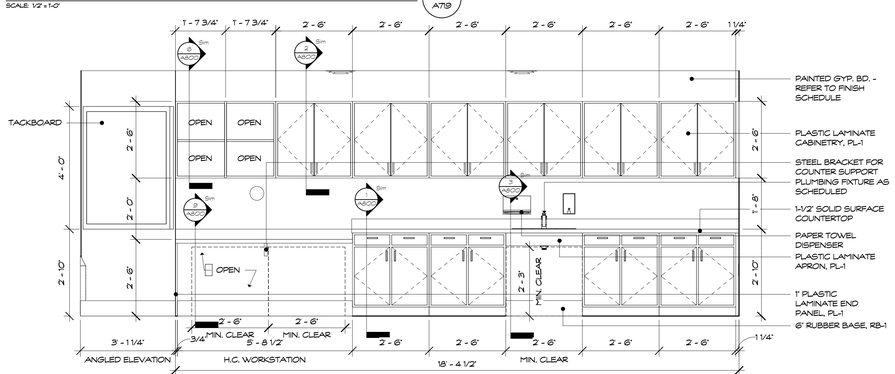
NORTH LEARNING CENTER CAFE AREA - SOUTH (3 / A719)
SCALE: 1/2" = 1'-0"



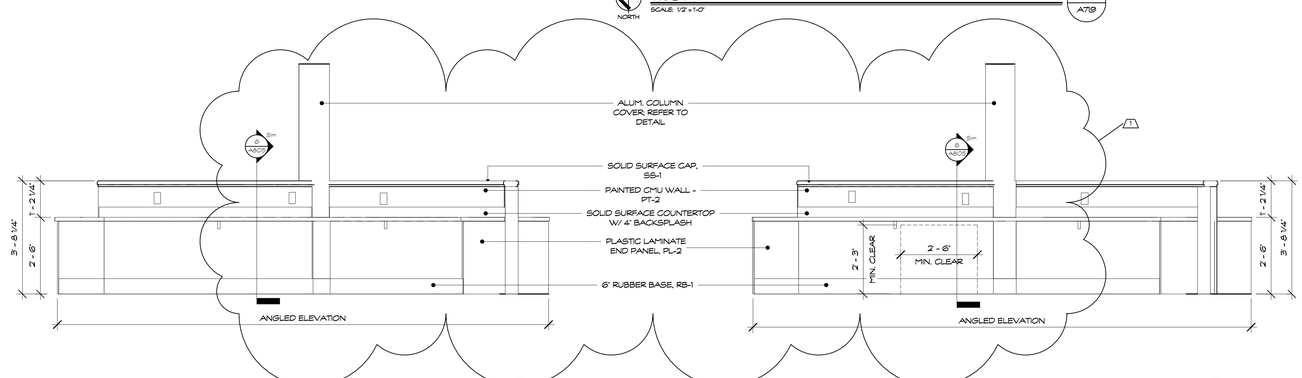
NORTH LEARNING CENTER CAFE AREA - WEST (4 / A719)
SCALE: 1/2" = 1'-0"



NORTH LEARNING CENTER WORK ROOM/MEETING AREA CASEWORK - WEST (6 / A719)
SCALE: 1/2" = 1'-0"



NORTH LEARNING CENTER MAKERSPACE CASEWORK - EAST (7 / A719)
SCALE: 1/2" = 1'-0"



NORTH LEARNING CENTER CAFE AREA BUILT-IN DESK - NORTH (8 / A719)
SCALE: 1/2" = 1'-0"

NORTH LEARNING CENTER CAFE AREA BUILT-IN DESK - SOUTH (9 / A719)
SCALE: 1/2" = 1'-0"

Project Title:

Expansion and Alterations to:
WEST SHORE MIDDLE SCHOOL
70 Kay Avenue, Milford CT 06460

SILVER / PETRUCELLI + ASSOCIATES
Architects / Engineers / Interior Designers

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Revision:	Description:	Date:	Revised By:
1	ADDENDUM #1	11/11/2016	JET

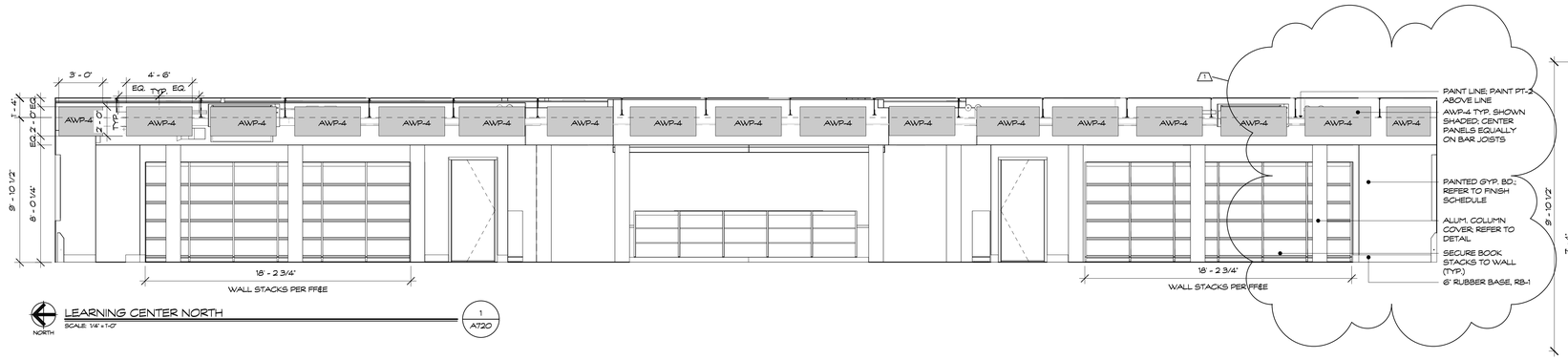
Revision:	Description:	Date:	Revised By:

Drawing Title:
Interior Elevations - Part 'C'
Learning Center

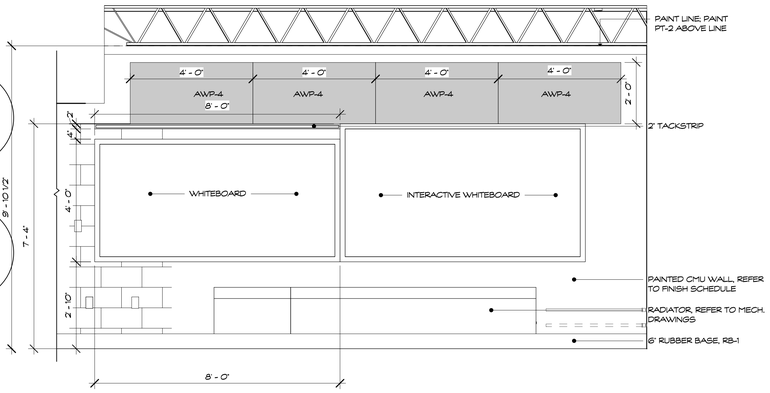
State Project Number: TMP-084-JLGB

Date: 8-18-2016
Scale: 1/2" = 1'-0"
Drawn By: JET
Project Number: 14.278

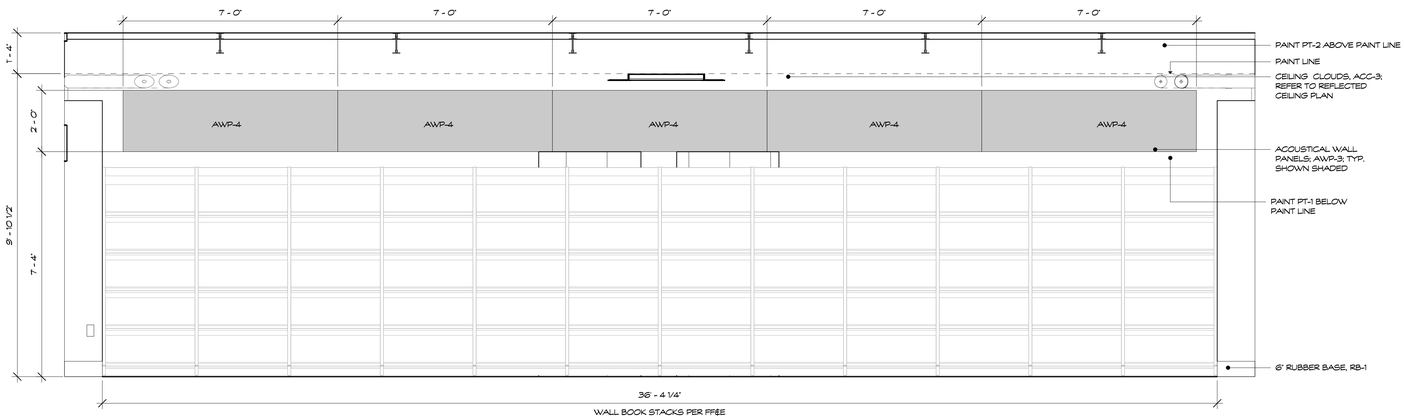
Drawing Number: A719



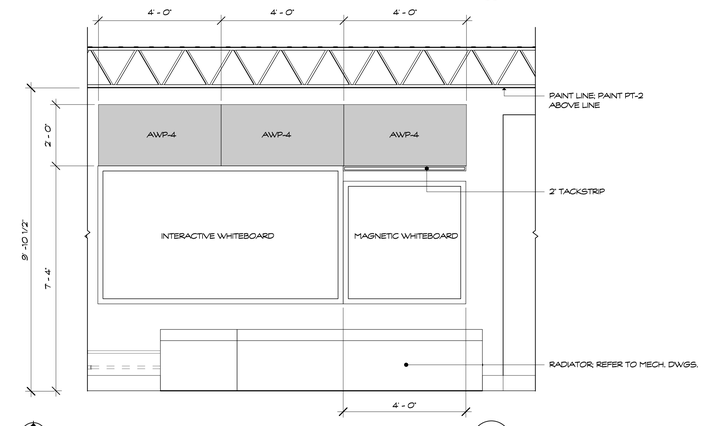
LEARNING CENTER NORTH
SCALE: 1/4" = 1'-0"
1 / A720



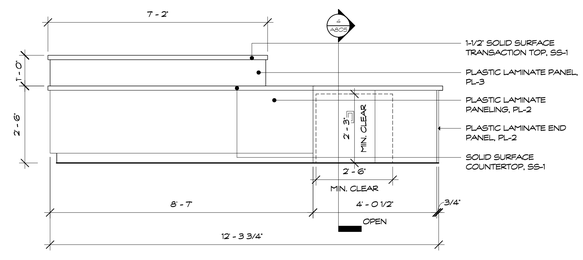
TYPICAL LEARNING CENTER TEACHING WALL
SCALE: 1/2" = 1'-0"
2 / A720



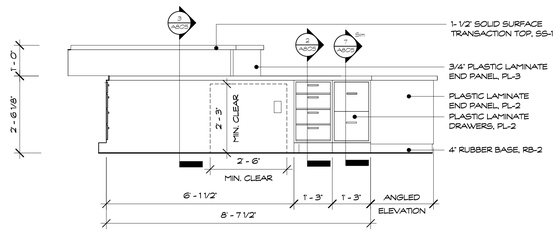
LEARNING CENTER - SOUTH
SCALE: 1/2" = 1'-0"
3 / A720



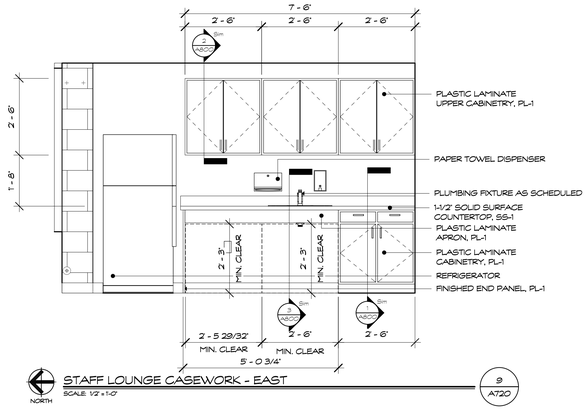
LEARNING CENTER - WEST
SCALE: 1/2" = 1'-0"
4 / A720



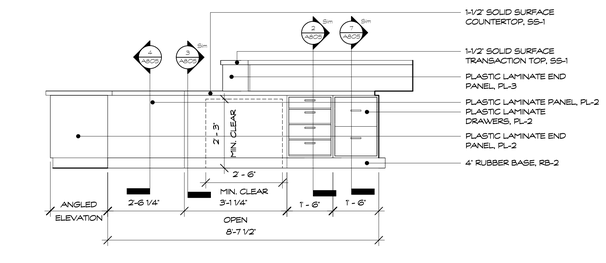
LEARNING CENTER CIRCULATION DESK - NORTHWEST
SCALE: 1/2" = 1'-0"
5 / A720



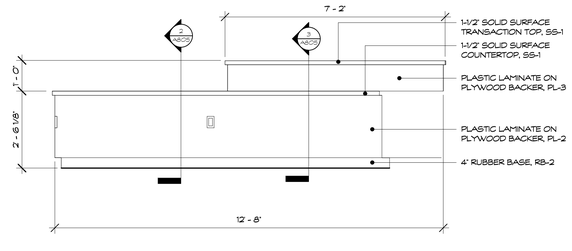
LEARNING CENTER CIRCULATION DESK - SOUTHWEST
SCALE: 1/2" = 1'-0"
6 / A720



STAFF LOUNGE CASEWORK - EAST
SCALE: 1/2" = 1'-0"
9 / A720



LEARNING CENTER CIRCULATION DESK - SOUTHEAST
SCALE: 1/2" = 1'-0"
7 / A720



LEARNING CENTER CIRCULATION DESK - NORTHEAST
SCALE: 1/2" = 1'-0"
8 / A720

Project Title:

Expansion and Alterations to:

WEST SHORE MIDDLE SCHOOL

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Revision:	Description:	Date:	Revised By:
1	ADDENDUM #1	11/11/2016	JET

Revision:	Description:	Date:	Revised By:

Drawing Title:

Interior Elevations - Part 'C'
Learning Center & Staff Lounge

State Project Number: TMP-084-JLGB

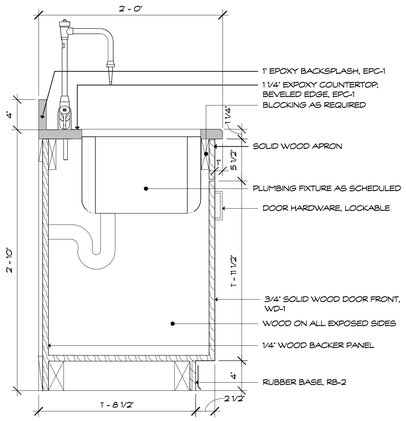
Date: 8-18-2016

Scale: As indicated

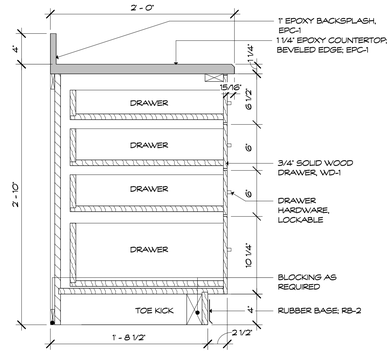
Drawn By: JET

Project Number: 14-278

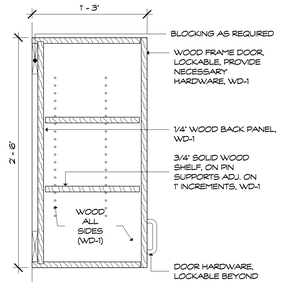
Drawing Number: A720



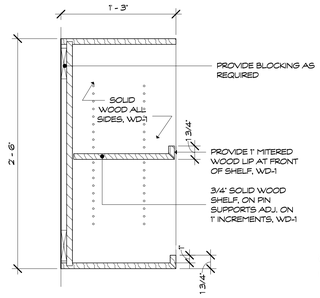
SCIENCE BASE CABINET W/ SINK (1 / A801)
SCALE: 1 1/2" = 1'-0" REFERENCE VIEW: 2 / A710



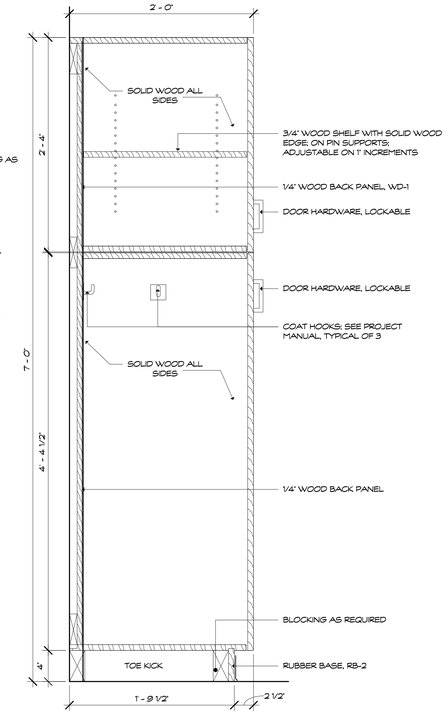
TYPICAL WOOD DRAWERS (2 / A801)
SCALE: 1 1/2" = 1'-0"



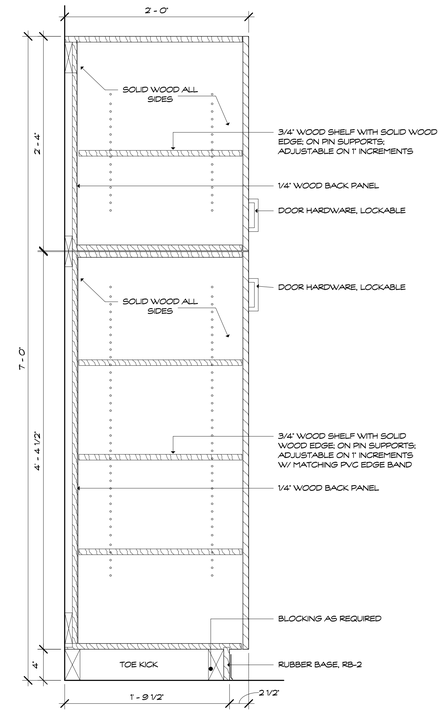
TYPICAL WOOD UPPER CABINET (3 / A801)
SCALE: 1 1/2" = 1'-0"



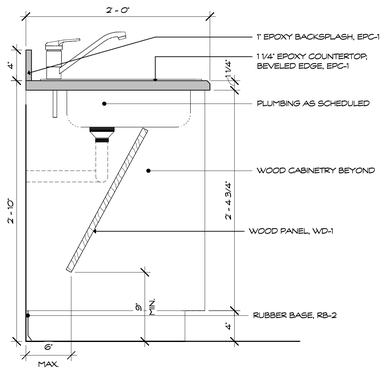
SCIENCE OPEN UPPER WOOD SHELVING (8 / A801)
SCALE: 1 1/2" = 1'-0"



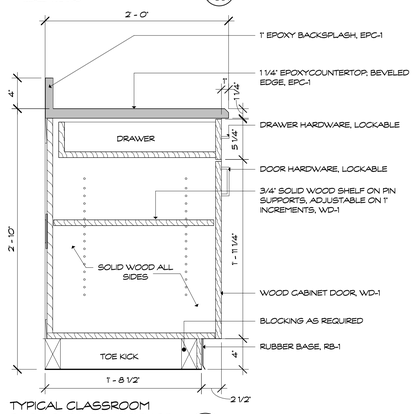
TYPICAL WOOD WARDROBE (4 / A801)
SCALE: 1 1/2" = 1'-0"



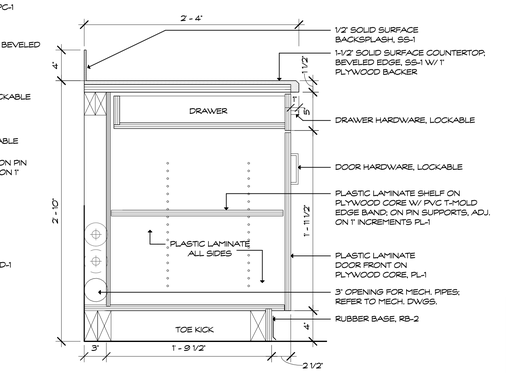
TYPICAL WOOD STORAGE CABINET (5 / A801)
SCALE: 1 1/2" = 1'-0"



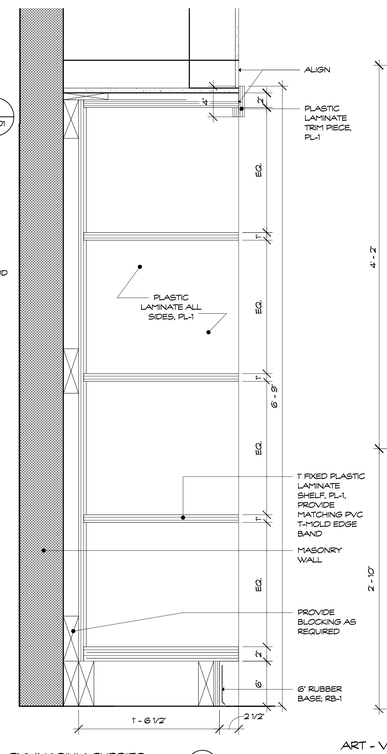
SCIENCE OPEN COUNTER W/ SINK (6 / A801)
SCALE: 1 1/2" = 1'-0"



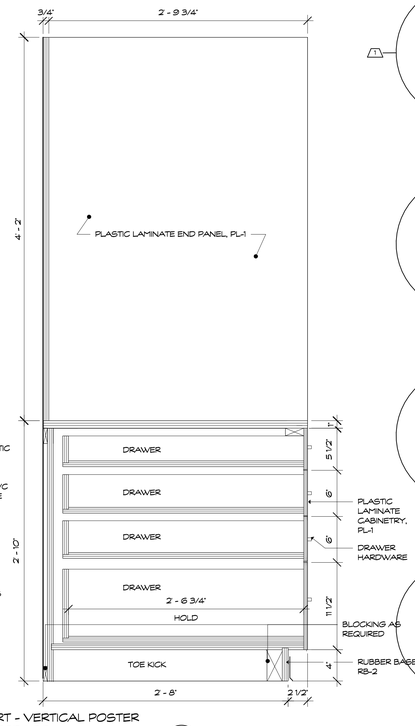
TYPICAL CLASSROOM BASE CABINET - SCIENCE (7 / A801)
SCALE: 1 1/2" = 1'-0"



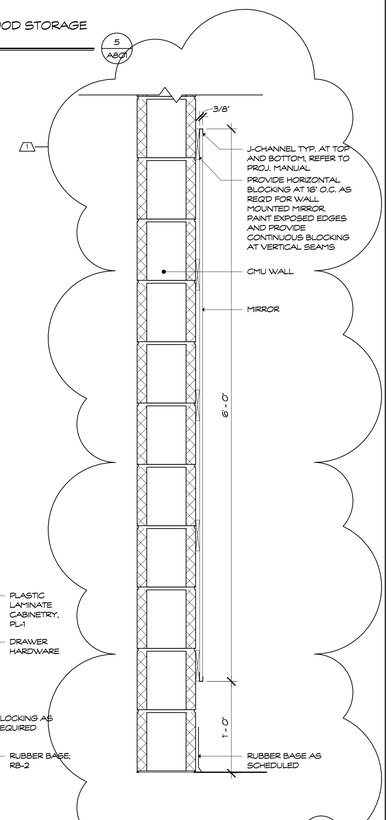
STAFF WORKROOM 186 BASE CABINET DETAIL (11 / A801)
SCALE: 1 1/2" = 1'-0"



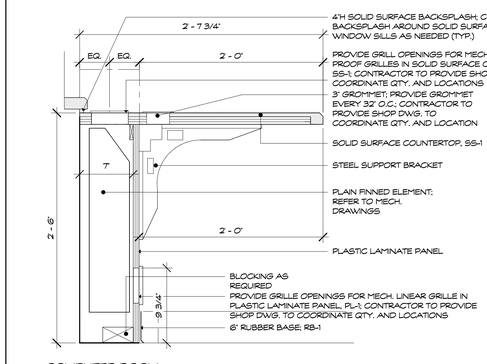
GYMNASIUM CUBBIES (12 / A801)
SCALE: 1 1/2" = 1'-0"



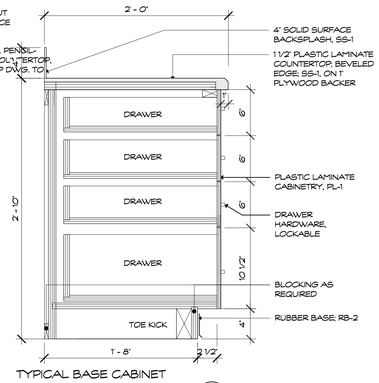
ART - VERTICAL POSTER STORAGE (13 / A801)
SCALE: 1 1/2" = 1'-0"



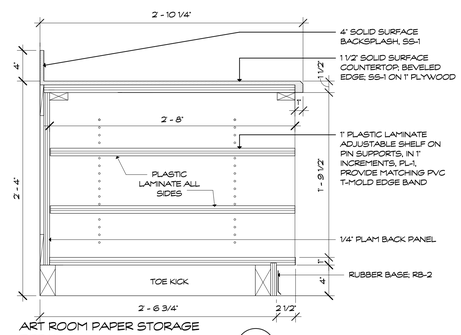
EXERCISE ROOM MIRROR (17 / A801)
SCALE: 1 1/2" = 1'-0" REFERENCE VIEW: 8 / A715



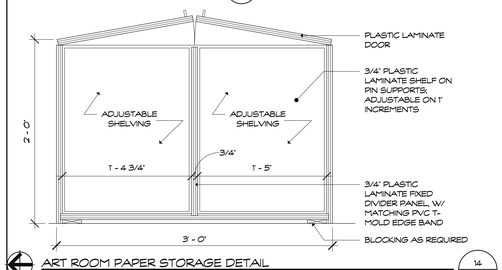
COMPUTER ROOM RADIATOR DETAIL (9 / A801)
SCALE: 1 1/2" = 1'-0"



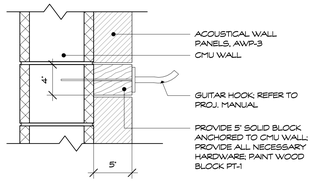
TYPICAL BASE CABINET DRAWERS (10 / A801)
SCALE: 1 1/2" = 1'-0"



ART ROOM PAPER STORAGE DETAIL (15 / A801)
SCALE: 1 1/2" = 1'-0" REFERENCE VIEW: 3 / A711



ART ROOM PAPER STORAGE DETAIL (14 / A801)
SCALE: 1 1/2" = 1'-0"



GUITAR HOOK DETAIL (16 / A801)
SCALE: 1 1/2" = 1'-0"

Project Title:

Expansion and Alterations to:

WEST SHORE MIDDLE SCHOOL

70 Kay Avenue, Milford CT 06460

SILVER / PETRUCELLI + ASSOCIATES
Architects / Engineers / Interior Designers

3190 Whitney Avenue, Hamden, CT 06518-2340
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Revision:	Description:	Date:	Revised By:
1	ADDENDUM #1	11/1/2016	JET

Revision:	Description:	Date:	Revised By:

Drawing Title: Casework Details

State Project Number: TMP-084-JLGB

Date: 8-18-2016

Scale: 1 1/2" = 1'-0"

Drawn By: JET

Project Number: 14.278

Drawing Number: A801

DOOR SCHEDULE - FIRST FLOOR

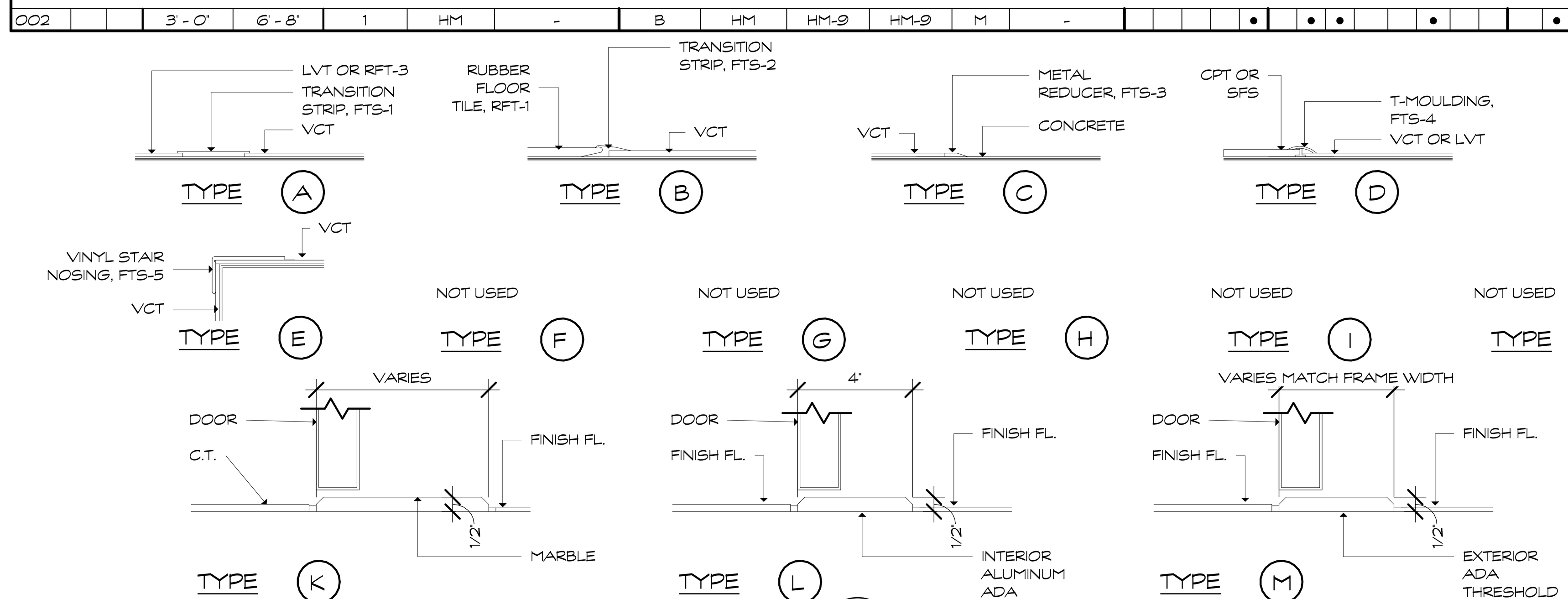
NUMBER	EVEN DOUBLE LEAF	WIDTH	HEIGHT	DOOR TYPE	DOOR MATERIAL	GLAZING - DOOR	FRAME TYPE	FRAME MATERIAL	HEAD DETAIL	JAMB DETAIL	SADDLE DETAIL	GLAZING - FRAME	SIGNAGE TYPE	SIGNAGE TEXT (COORDINATE FINAL TEXT WITH OWNER AND ARCHITECT). FOR DETAILS, MOUNTING HEIGHT AND LOCATION, SEE DETAILS 2, 3, 4 / A920	REMARKS
102A		3' - 0"	7 - 0"	3	WD	1/4" FIRE	B	HM	HM-11	HM-11	-	-	S1	ART CLASSROOM	
102B		3' - 0"	7 - 0"	3	WD	1/4" FIRE	B	HM	HM-1	HM-1	-	-	S1	ART STORAGE	
102C		3' - 0"	7 - 0"	3	WD	1/4" FIRE	B	HM	HM-1	HM-1	-	-	S1	KILN ROOM	
102D		3' - 0"	7 - 2"	4	HM	1/4" TEMP	SEE EL.	HM	SEE EL.	SEE EL.	SEE EL.	GL-3, 1/4" TEMPERED, TRANSLUCENT (FROSTED)	S1	COURTYARD	2
104A		3' - 0"	7 - 2"	4	HM	1/4" TEMP	SEE EL.	HM	SEE EL.	SEE EL.	SEE EL.	GL-3, 1/4" TEMPERED, TRANSLUCENT (FROSTED)	S1	COURTYARD	2
104B		3' - 0"	7 - 0"	3	WD	1/4" FIRE	B	HM	HM-1	HM-1	-	-	S1	KILN ROOM	
104C		3' - 0"	7 - 0"	3	WD	1/4" FIRE	B	HM	HM-1	HM-1	-	-	S1	ART STROAGE	
104H		0' - 0"	0' - 0"												
127		3' - 0"	7 - 0"	1	WD	-	B	HM	HM-11	HM-11	K	-	S3	BOYS	
129		3' - 0"	7 - 0"	1	WD	-	B	HM	HM-11	HM-11	K	-	S2	GIRLS	
130	•	8' - 0"	7 - 0"	4	ALUM	GL-6, CLEAR, LAMINATED, FIRE RATED	SEE EL.	ALUM	SEE EL.	SEE EL.	SEE EL.	GL-6, CLEAR, LAMINATED, FIRE RATED	S1	COURTYARD	2
130A	•	8' - 0"	7 - 0"	3	HM	1/4" FIRE	B	HM	HM-1	HM-1	-	-	S8	EXIT	5
130B	•	8' - 0"	7 - 0"	3	HM	1/4" FIRE	B	HM	HM-1	HM-1	-	-	S8	EXIT	5
130C		3' - 0"	7 - 0"	3	HM	-	B	HM	HM-1	HM-1	-	-	S8	EXIT	
130D		3' - 5"	7 - 0"	4	ALUM	GL-6, CLEAR, LAMINATED, FIRE RATED	SEE EL.	ALUM	SEE EL.	SEE EL.	SEE EL.	GL-6, CLEAR, LAMINATED, FIRE RATED	S8	EXIT	1, 2
130E		3' - 5"	7 - 0"	4	ALUM	GL-6, CLEAR, LAMINATED, FIRE RATED	SEE EL.	ALUM	SEE EL.	SEE EL.	SEE EL.	GL-6, CLEAR, LAMINATED, FIRE RATED			1, 2
130F		3' - 5"	7 - 0"	4	ALUM	GL-6, CLEAR, LAMINATED, FIRE RATED	SEE EL.	ALUM	SEE EL.	SEE EL.	SEE EL.	GL-6, CLEAR, LAMINATED, FIRE RATED			1, 2
130G		3' - 5"	7 - 0"	4	ALUM	GL-6, CLEAR, LAMINATED, FIRE RATED	SEE EL.	ALUM	SEE EL.	SEE EL.	SEE EL.	GL-6, CLEAR, LAMINATED, FIRE RATED			1, 2
130H		3' - 5"	7 - 0"	4	ALUM	GL-6, CLEAR, LAMINATED, FIRE RATED	SEE EL.	ALUM	SEE EL.	SEE EL.	SEE EL.	GL-6, CLEAR, LAMINATED, FIRE RATED			1, 2
130J		3' - 5"	7 - 0"	4	ALUM	GL-6, CLEAR, LAMINATED, FIRE RATED	SEE EL.	ALUM	SEE EL.	SEE EL.	SEE EL.	GL-6, CLEAR, LAMINATED, FIRE RATED			1, 2
132		3' - 4"	7 - 0"	3	HM	1/4" TEMP	D	HM	HM-1	HM-1	L	-	S1	GYMNASIUM	
132.1		3' - 4"	7 - 0"	3	HM	1/4" TEMP	D	HM	HM-1	HM-1	L	-			
132.2		3' - 4"	7 - 0"	3	HM	1/4" TEMP	D	HM	HM-1	HM-1	L	-			1
132.3	•	6' - 0"	7 - 0"	3	WD	1/4" TEMP	B	HM	HM-1	HM-1	L	-	S1	GYMNASIUM	5, 1
132.4	•	6' - 0"	7 - 0"	3	WD	1/4" TEMP	B	HM	HM-1	HM-1	L	-			5,1
132.5	•	6' - 0"	7 - 0"	3	WD	-	B	HM	HM-10	HM-10	M	-	S8	EXIT	3
132.6	•	6' - 2"	7 - 0"	4	ALUM	GL-6, CLEAR, LAMINATED, FIRE RATED	SEE EL.	ALUM	SEE EL.	SEE EL.	SEE EL.	GL-6, CLEAR, LAMINATED, FIRE RATED	S8	EXIT	1, 2
132A		3' - 0"	7 - 0"	1	HM	-	B	HM	HM-1	HM-1	L	-	S1	IDF	
133		3' - 0"	7 - 0"	3	WD	1/4" TEMP	B	HM	HM-1	HM-1	L	-	S1	EXERCISE ROOM	
133A	•	6' - 0"	7 - 0"	3	WD	1/4" TEMP	B	HM	HM-1	HM-1	L	-	S1	EXERCISE ROOM	
133C		3' - 0"	7 - 0 3/4"	4	HM	1/4" TEMP	SEE EL.	HM	SEE EL.	SEE EL.	M	GL-3, 1/4" TEMPERED, TRANSLUCENT (FROSTED)	S1	COURTYARD	
134		3' - 0"	7 - 0"	3	WD	1/4" TEMP	B	HM	HM-5	HM-5	L	-	S1	OFFICE	
135		3' - 0"	7 - 0"	1	HM	-	B	HM	HM-5	HM-5	L	-	S1	SPRINKLER ROOM	
136	•	6' - 0"	7 - 0"	1	HM	-	B	HM	HM-5	HM-5	L	-	S1	GYM STORAGE	
137	•	6' - 0"	7 - 0"	1	HM	-	B	HM	HM-5	HM-5	L	-	S1	GYM STORAGE	
138		3' - 0"	7 - 0"	1	WD	-	B	HM	HM-1	HM-1	-	-	S1	STORAGE	
139		3' - 0"	7 - 0"	1	WD	-	B	HM	HM-1	HM-1	K	-	S3	BOYS	
139A		3' - 0"	7 - 0"	1	WD	-	B	HM	HM-1	HM-1	C	-	S1	STORAGE	
140		3' - 0"	7 - 0"	2	WD	1/4" TEMP	B	HM	HM-1	HM-1	-	-	S1	OFFICE	
141		3' - 0"	7 - 0"	1	WD	-	B	HM	HM-1	HM-1	K	-	S2	GIRLS	
141A		3' - 0"	7 - 0"	1	WD	-	B	HM	HM-1	HM-1	C	-	S1	CUSTODIAL	
142		3' - 0"	7 - 0"	1	WD	-	B	HM	HM-1	HM-1	K	-	S1	FAMILY TOILET	
143A		3' - 0"	7 - 0"	1	WD	-	B	HM	HM-1	HM-1	B	-	S1	IDF	
145		6' - 0"	7 - 0"	1	HM	-	B	HM	HM-1	HM-1	L	-	S1	STORAGE	
146		3' - 0"	7 - 0"	1	HM	-	B	HM	HM-1	HM-1	L	-	S1	STORAGE	
147		3' - 0"	7 - 0"	3	WD	1/4" TEMP	B	HM	HM-1	HM-1	-	-	S1	GENERAL MUSIC	
148	•	6' - 0"	7 - 0"	3	WD	1/4" TEMP	B	HM	HM-1	HM-1	-	-	S1	BAND	5
148B	•	6' - 0"	8' - 4"	1	HM	-	B	HM	HM-13	HM-13	L	-	S1	STAGE	7
149		3' - 0"	7 - 0"	1	HM	-	B	HM	HM-1	HM-1	C	-	S1	ELECTRICAL	
149A		3' - 0"	7 - 0"	1	HM	-	B	HM	HM-6	HM-6	M	-	S1	SWITCHGEAR	
150		3' - 0"	7 - 0"	1	WD	-	B	HM	HM-1	HM-1	-	-	S1	STORAGE	
151	•	6' - 0"	7 - 0"	3	WD	-	B	HM	HM-1	HM-1	B	-	S1	MUSIC STORAGE	5
152	•	6' - 0"	7 - 0"	4	ALUM	GL-6, CLEAR, LAMINATED, FIRE RATED	SEE EL.	ALUM	SEE EL.	SEE EL.	SEE EL.	GL-6, CLEAR, LAMINATED, FIRE RATED	S8	EXIT	1, 2
152A	•	6' - 0"	7 - 0"	4	ALUM	GL-6, CLEAR, LAMINATED, FIRE RATED	SEE EL.	ALUM	SEE EL.	SEE EL.	SEE EL.	GL-6, CLEAR, LAMINATED, FIRE RATED	S8	EXIT	1, 2
153	•	6' - 0"	7 - 0"	3	WD	1/4" TEMP	B	HM	HM-1	HM-1	B	-	S1	CHORUS	5
153A		3' - 0"	7 - 0"	1	HM	-	B	HM	HM-6	HM-6	M	-	S8	EXIT	3
156		3' - 0"	7 - 0"	3	WD	1/4" TEMP	B	HM	HM-2	HM-2	B	-	S1	CLASSROOM	
156A		3' - 0"	7 - 0"	1	HM	-	-	HM	-	-	EX	-	S8	EXIT	3,4
158A		3' - 0"	7 - 0"	1	HM	-	-	HM	-	-	EX	-	S8	EXIT	3,4
160	•	6' - 0"	7 - 0"	2	WD	1/4" TEMP	B	HM	HM-2	HM-2	A	-	S1	MEDIA CENTER	
160A		3' - 0"	7 - 0"	1	HM	-	B	HM	HM-5	HM-5	M	-	S8	EXIT	
160B		3' - 0"	7 - 0"	1	HM	-	B	HM	HM-5	HM-5	M	-	S8	EXIT	
161		3' - 0"	7 - 0"	4	HM	1/4" TEMP	E	HM	HM-7	HM-7	A	GL-3, 1/4" TEMPERED, TRANSLUCENT (FROSTED)	S1	COMPUTER LAB	
161A		3' - 0"	7 - 0"	3	WD	1/4" FIRE	B	HM	HM-1	HM-1	-	-	S1	COMPUTER ROOM	
161C		3' - 0"	7 - 8 3/4"	4	ALUM	GL-8, CLEAR BALLISTIC, FIRE RATED	SEE EL.	ALUM	SEE EL.	SEE EL.	SEE EL.	1" INSUL FIRE	S1	GREETER	
162		3' - 0"	7 - 0"	3	WD	1/4" TEMP	A	HM	HM-4	HM-4	A	-	S1	MAKERSPACE	
163		3' - 0"	7 - 0"	3	WD	1/4" TEMP	A	HM	HM-4	HM-4	A	-	S1	GREEN SCREEN	
163A		3' - 0"	7 - 0"	3	WD	1/4" TEMP	A	HM	HM-4	HM-4	-	-	S1	GREEN SCREEN	
164		3' - 0"	7 - 0"	3	WD	1/4" TEMP	A	HM	HM-4	HM-4	A	-	S1	MEDIA OFFICE	
165		3' - 0"	7 - 0"	3	WD	1/4" TEMP	A	HM	HM-4	HM-4	A	-	S1	WORK ROOM	
166		3' - 0"	7 - 0"	1	WD	-	A	HM	HM-4	HM-4	A	-	S1	IDF	
167		3' - 0"	7 - 0"	1	WD	-	B	HM	HM-1	HM-1	K	-	S3	BOYS	
168		3' - 0"	7 - 0"	1	WD	-	B	HM	HM-1	HM-1	K	-	S2	GIRLS	
168A		3' - 0"	7 - 0"	1	WD	-	B	HM	HM-1	HM-1	C	-	S1	CUSTODIAL	
169		3' - 0"	7 - 0"	1	WD	-	B	HM	HM-2	HM-2	-	-	S1	SECURITY OFFICE	
170		3' - 0"	7 - 0"	1	WD	-	B	HM	HM-2	HM-2	-	-	S1	STAFF LOUNGE	
171		3' - 0"	7 - 0"	1	HM	-	B	HM	HM-1	HM-1	K	-	S5	UNISEX	
172	•	8' - 0"	7 - 0"	3	HM	1/4" FIRE	H.1	HM	HM-7	HM-7	-	1/4" FIRE	S8	EXIT	
172A	•	6' - 0"	7 - 0 3/4"	4	ALUM	GL-6, CLEAR, LAMINATED, FIRE RATED	SEE EL.	ALUM	SEE EL.	SEE EL.	SEE EL.	GL-6, CLEAR, LAMINATED, FIRE RATED	S8	EXIT	1, 2
172D	•	6' - 0"	7 - 0 3/4"	4	ALUM	GL-6, CLEAR, LAMINATED, FIRE RATED	SEE EL.	ALUM	SEE EL.	SEE EL.	SEE EL.	GL-6, CLEAR, LAMINATED, FIRE RATED	S8	EXIT	1, 2
174	•	6' - 0"	7 - 0"	1	HM	-	B	HM	HM-6	HM-6	M	-	S1	STORAGE	
178	•	6' - 0"	7 - 0"	1	HM	-	B	HM	HM-6	HM-6	M	-	S8	EXIT	
179		3' - 0"	6' - 8"	3	WD	1/4" FIRE	B	HM	HM-12	HM-12	-	-	S1	RESOURCE ROOM	
180	•	6' - 0"	7 - 8 3/4"	4	ALUM	GL-6, CLEAR, LAMINATED, FIRE RATED	SEE EL.	ALUM	SEE EL.	SEE EL.	SEE EL.	GL-6, CLEAR, LAMINATED, FIRE RATED			1, 2
180.1	•	6' - 0"	7 - 8 3/4"	4	ALUM	GL-6, CLEAR, LAMINATED, FIRE RATED	SEE EL.	ALUM	SEE EL.	SEE EL.	SEE EL.	GL-6, CLEAR, LAMINATED, FIRE RATED			1, 2
181A		3' - 0"	7 - 0"	2	WD	1/4" FIRE	B	HM	HM-2	HM-2	-	-	S1	MAIN OFFICE	
181B		3' - 0"	7 - 8 3/4"	4	ALUM	GL-6, CLEAR, LAMINATED, FIRE RATED	SEE EL.	ALUM	SEE EL.	SEE EL.	SEE EL.	1" INSUL FIRE	S1	MAIN OFFICE	
183		3' - 0"	7 - 0"	1	WD	-	B	HM	HM-1	HM-1	K	-	S5	UNISEX	
184		3' - 0"	7 - 0"	2	WD	1/4" FIRE	B	HM	HM-1	HM-1	-	-	S1	ASSISTANT PRINCIPAL	
185		3' - 0"	7 - 0"	1	WD	-	B	HM	HM-1	HM-1	-	-	S1	STORAGE	
187		3' - 0"	7 - 0"	2	WD	1/4" TEMP	B	HM	HM-1	HM-1	-	-	S1	CONFERENCE ROOM	
189		3' - 0"	7 - 0"	2	WD	1/4" FIRE	B	HM	HM-2	HM-2	-	-	S1	PRINCIPAL	
189A		3' - 0"	7 - 0"	2	WD	-	B	HM	HM-1	HM-1		-	S1	PRINCIPAL	
191A	•	6' - 0"	7 - 8 3/4"	4	ALUM	GL-6, CLEAR, LAMINATED, FIRE RATED	SEE EL.	ALUM	SEE EL.	SEE EL.	SEE EL.	GL-6, CLEAR, LAMINATED, FIRE RATED	S8	EXIT	
194	•	6' - 0"	7 - 0"	1	HM	-	C	HM	HM-1	HM-1	-	-	S8	EXIT	5
195	•	6' - 0"	7 - 0"	1	HM	-	C	HM	HM-2	HM-2	-	-	S8	EXIT	5

DOOR SCHEDULE - SECOND FLOOR

NUMBER	EVEN DOUBLE LEAF	WIDTH	HEIGHT	DOOR TYPE	DOOR MATERIAL	GLAZING - DOOR	FRAME TYPE	FRAME MATERIAL	HEAD DETAIL	JAMB DETAIL	SADDLE DETAIL	GLAZING - FRAME	SIGNAGE TYPE	SIGNAGE TEXT	REMARKS
201A		3' - 0"	7 - 0"	2	WD	1/4" TEMP	A	HM	HM-4	HM-4	A	-	S1	OFFICE	
201B		3' - 0"	7 - 0"	2	WD	1/4" TEMP	A	HM	HM-4	HM-4	A	-	S1	OFFICE	
201C		3' - 0"	7 - 0"	2	WD	1/4" TEMP	A	HM	HM-4	HM-4	A	-	S1	OFFICE	
201D		3' - 0"	7 - 0"	2	WD	1/4" TEMP	A	HM	HM-4	HM-4	A	-	S1	OFFICE	
214		3' - 0"	7 - 0"	1	WD	-	B	HM	HM-11	HM-11	K	-	S3	BOYS	
216		3' - 0"	7 - 0"	1	WD	-	B	HM	HM-11	HM-11	K	-	S2	GIRLS	

DOOR SCHEDULE - BOILER ROOM

NUMBER	EVEN DOUBLE LEAF	WIDTH	HEIGHT	DOOR TYPE	DOOR MATERIAL	GLAZING - DOOR	FRAME TYPE	FRAME MATERIAL	HEAD DETAIL	JAMB DETAIL	SADDLE DETAIL	GLAZING - FRAME	SIGNAGE TYPE	SIGNAGE TEXT	REMARKS
002		3' - 0"	6' - 8"	1	HM	-	B	HM	HM-9	HM-9	M	-	S8	EXIT	



FLOOR TRANSITION DETAILS
SCALE: 3" = 1-0" REFERENCE VIEW: 1 / A910

DOOR SCHEDULE ABBREVIATIONS & SYMBOLS

- • - INDICATES NEW WORK
- O - INDICATES EXISTING TO REMAIN
- · - REFER TO WINDOW AND CURTAIN WALL ELEVATIONS
- AL - ALUMINUM
- EXIST - EXISTING
- EXT - EXTERIOR
- F.R.S.G. - FIRE RATED SAFETY GLASS
- FRP - FIBERGLASS REINFORCED POLYESTER
- HM - HOLLOW METAL
- INSUL - INSULATED
- S.G. - SAFETY GLASS
- STL - STEEL
- TEMP - TEMPERED
- WD - WOOD

GENERAL DOOR NOTES

1. CONTRACTOR SHALL FIELD VERIFY ALL CONDITIONS & DIMENSIONS.
2. ALL NEW KICK PLATES SHALL BE 16" HIGH AND OFFSET 1" FROM EDGES OF DOOR UNLESS OTHERWISE NOTED. CENTERED AT BOTTOM OF DOOR.
3. ALL GLASS IN DOORS, SIDELITES AND TRANSOMS SHALL BE TEMPERED UNLESS OTHERWISE NOTED. SEE SCHEDULE FOR SPECIFIC THICKNESS AND TYPE.
4. ALL EXTERIOR DOORS SHALL RECEIVE CONTACTS FOR ALARM SYSTEM.
5. PROVIDE DOGGING FUNCTION AT ALL PANIC BARS
6. ADDITIONAL CLOSERS TO BE PROVIDED AS REQ'D BY LOCAL AHJ SEE ALLOWANCES
7. ALL EXTERIOR DOUBLE DOORS TO RECEIVE KEYED REMOVABLE MULLIONS ADDITONAL CYLINDERS REQ'D

DOOR SCHEDULE REMARKS

1. OFFSET PULL WITH CYLINDER IN PANIC SEE HARDWARE SET
2. OVERHEAD STOP WITH HOLD OPEN
3. BLANK PLATE ON EXTERIOR NOT LEVER OR PULL
4. SAND, SCRAPE, FILL, AND PAINT EXISTING FRAME, PROVIDE NEW DOOR SLAB AND HARDWARE. SEE PROJ. MAN. AND SCHEDULE OF FINISHES
5. CONCEALED FLUSH BOLTS SEE PROJ. MAN.
6. EXISTING DOORS AND FRAMES TO BE RECERTIFIED IN THE FIELD. SEE ALLOWANCES
   FIRST FLOOR EXISTING DOORS/FRAMES TO BE VERIFIED FOR 45 MINUTE LABEL: 100, 101, 103, 104, 105, 106, 106A, 107, 127A, 129A, 127.1, 158, 170A, 172C, 173, 186, 188, 190, 110.1, 109, 111, 113, 115, 117, 116, 116.1, 112, 126
   FIRST FLOOR DOORS/FRAMES TO BE VERIFIED FOR 60 MIN. RATING: S3.1, S2A, S2.1A, S1.1A, 114
   FIRST FLOOR EXISTING DOORS/FRAMES TO BE VERIFIED FOR 90 MIN. RATING: 128, 147
   SECOND FLOOR DOORS/FRAMES TO BE VERIFIED FOR 45 MIN. RATING: 201, 203, 214A, 216A, 200, 202, 203, 204, 205, 207, 209, 211, 213, 215, 217, 206, 218
   SECOND FLOOR DOORS/FRAMES TO BE VERIFIED FOR 60 MIN. RATING: S1.2, S2.2, S3.2
   SECOND FLOOR DOORS TO BE VERIFIED FOR 90 MIN. RATING: 212
7. ACOUSTICAL ASSEMBLY SEE PROJ. MAN.

Project Title:
Expansion and Alterations to:
WEST SHORE MIDDLE SCHOOL
70 Kay Avenue, Milford CT 06460

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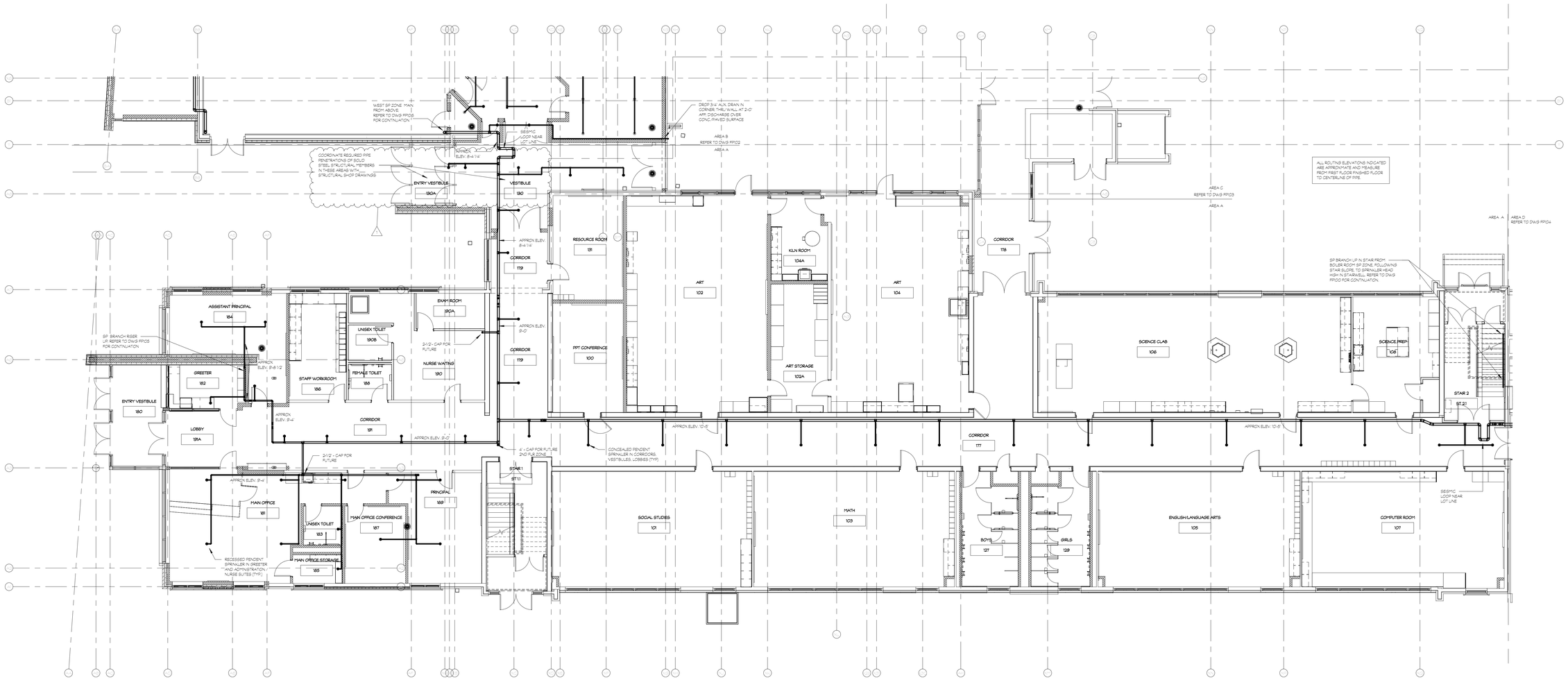
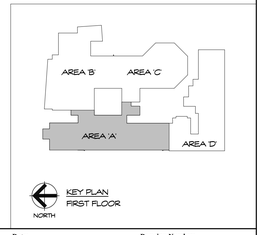
Revision:	Description:	Date:	Revised By:
1	ADDENDUM #1	11/1/2016	CON

Drawing Title: Door Schedule
State Project Number: TMP-084-JLGB
Date: 8/18/2016
Scale: As indicated
Drawn By: Author
Project Number: 14.216
Drawing Number: A910



1 / FP101 First Floor - Area A Fire Protection Plan
SCALE 1/8 = 1'-0"



Project Title:

Expansion and Alterations to:

WEST SHORE MIDDLE SCHOOL

70 Kay Avenue, Milford CT 06460

SILVER / PETRUCELLI + ASSOCIATES
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Revision:	Description:	Date:	Revised By:
1	ADDENDUM #1	1/1/2016	MBG

Revision:	Description:	Date:	Revised By:

Drawing Title:

FIRST FLOOR-AREA A
FIRE PROTECTION PLAN

State Project Number: TMP-084-JLGB

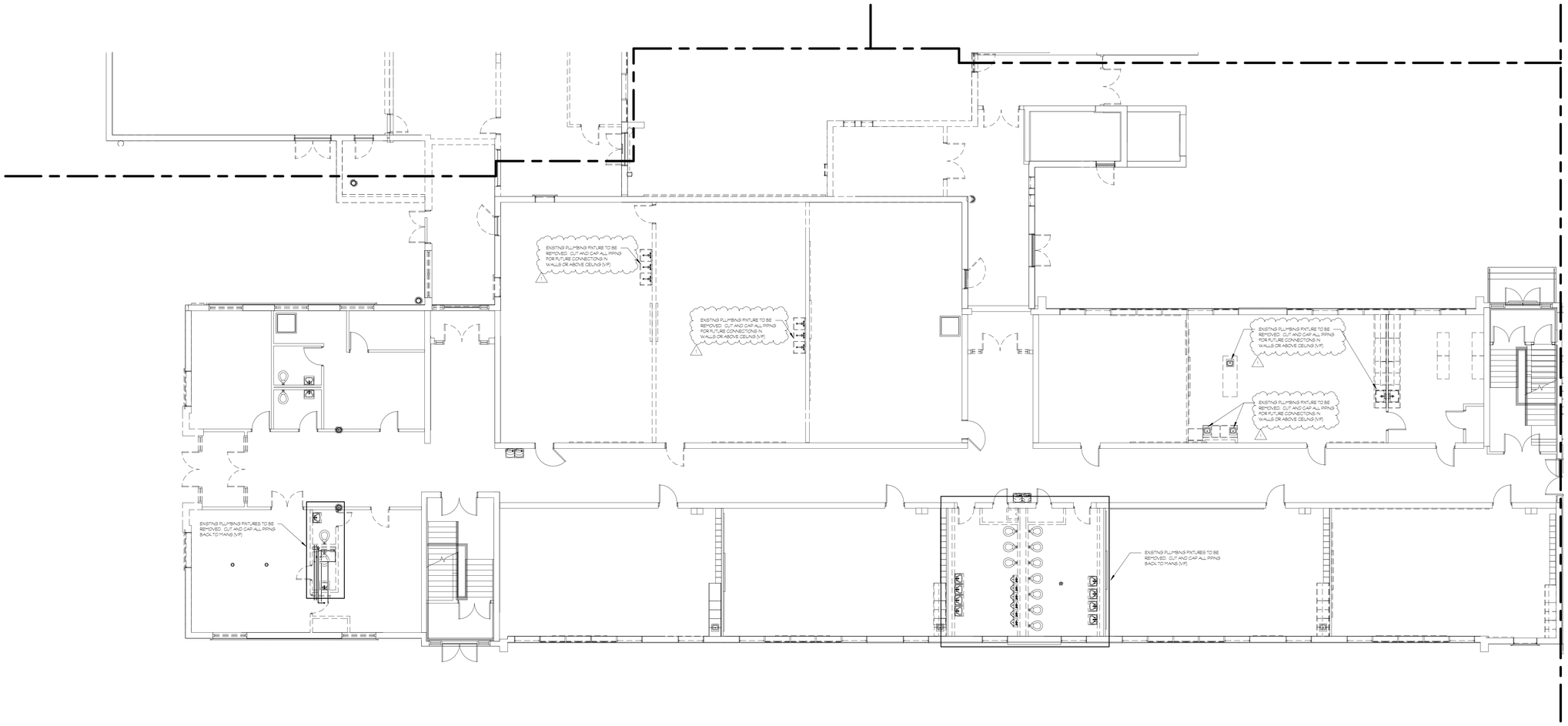
Date: 8-18-2016

Scale: 1/8 = 1'-0"

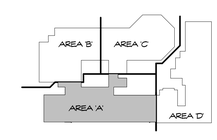
Drawn By: MBG

Project Number: 14.278

Drawing Number: FP101



1 P111 Main Level Demo Plan - Area 'A'
SCALE: 1/8"=1'-0"



NORTH
KEY PLAN
FIRST FLOOR

Project Title:

Expansion and Alterations to:
WEST SHORE MIDDLE SCHOOL

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Revision:	Description:	Date:	Revised By:
1	ADDENDUM #1	11/1/2018	ARC

Revision:	Description:	Date:	Revised By:

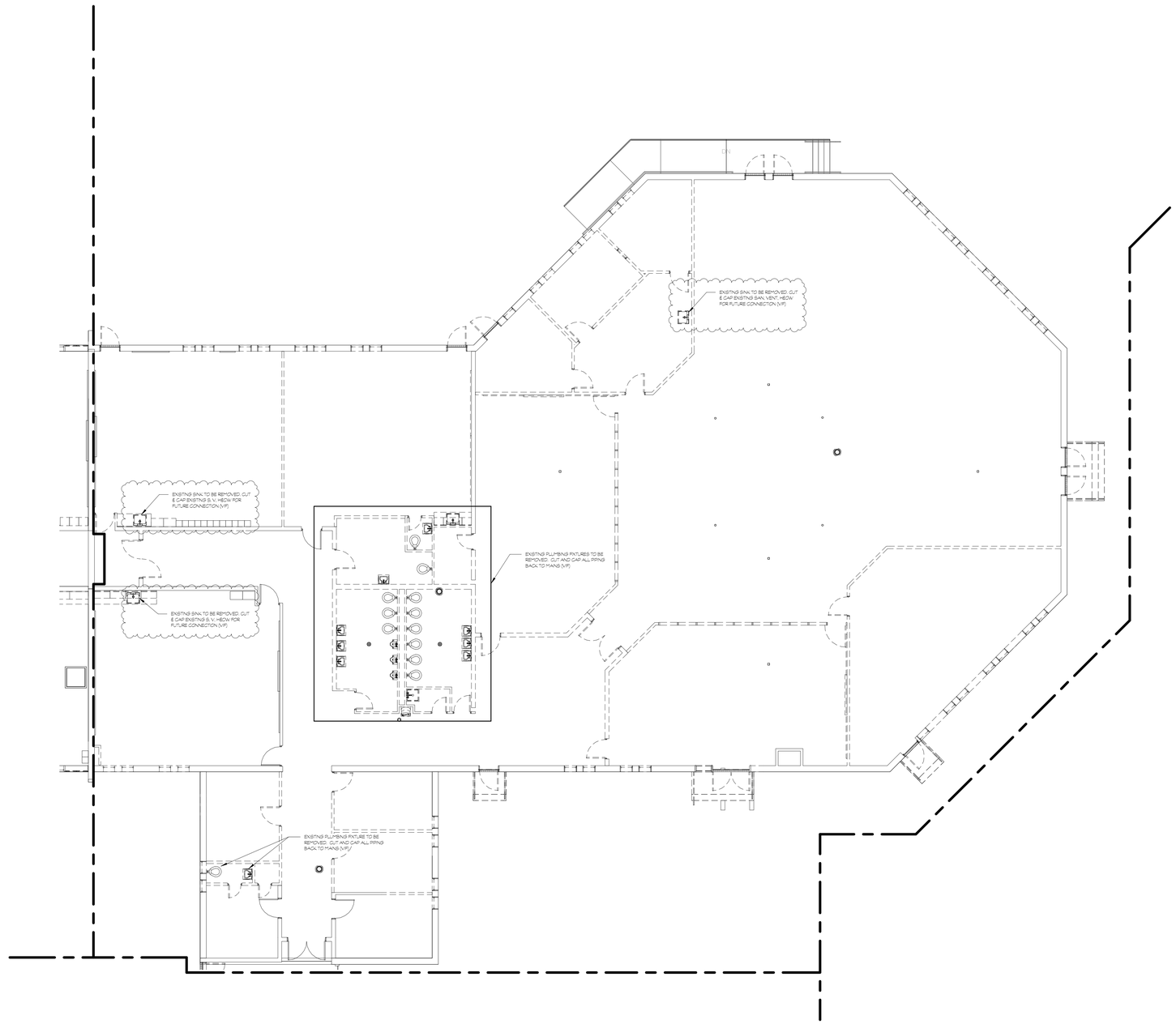
Drawing Title:

MAIN LEVEL DEMO PLAN - AREA 'A'

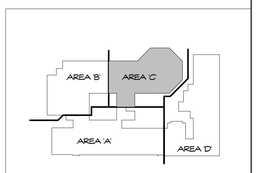
State Project Number: TMP-084-JLGB

Date: 8/18/2018
Scale: 1/8" = 1'-0"
Drawn By: ARC
Project Number: 14.278

Drawing Number: P111



1 / P13 Main Level Demo Plan - Area 'C'
SCALE 1/8 =1'-0'



NORTH
KEY PLAN
FIRST FLOOR

Project Title:

Expansion and Alterations to:
WEST SHORE MIDDLE SCHOOL
70 Kay Avenue, Milford CT 06460

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Revision:	Description:	Date:	Revised By:
1	ADDENDUM #1	1/1/2016	ARC

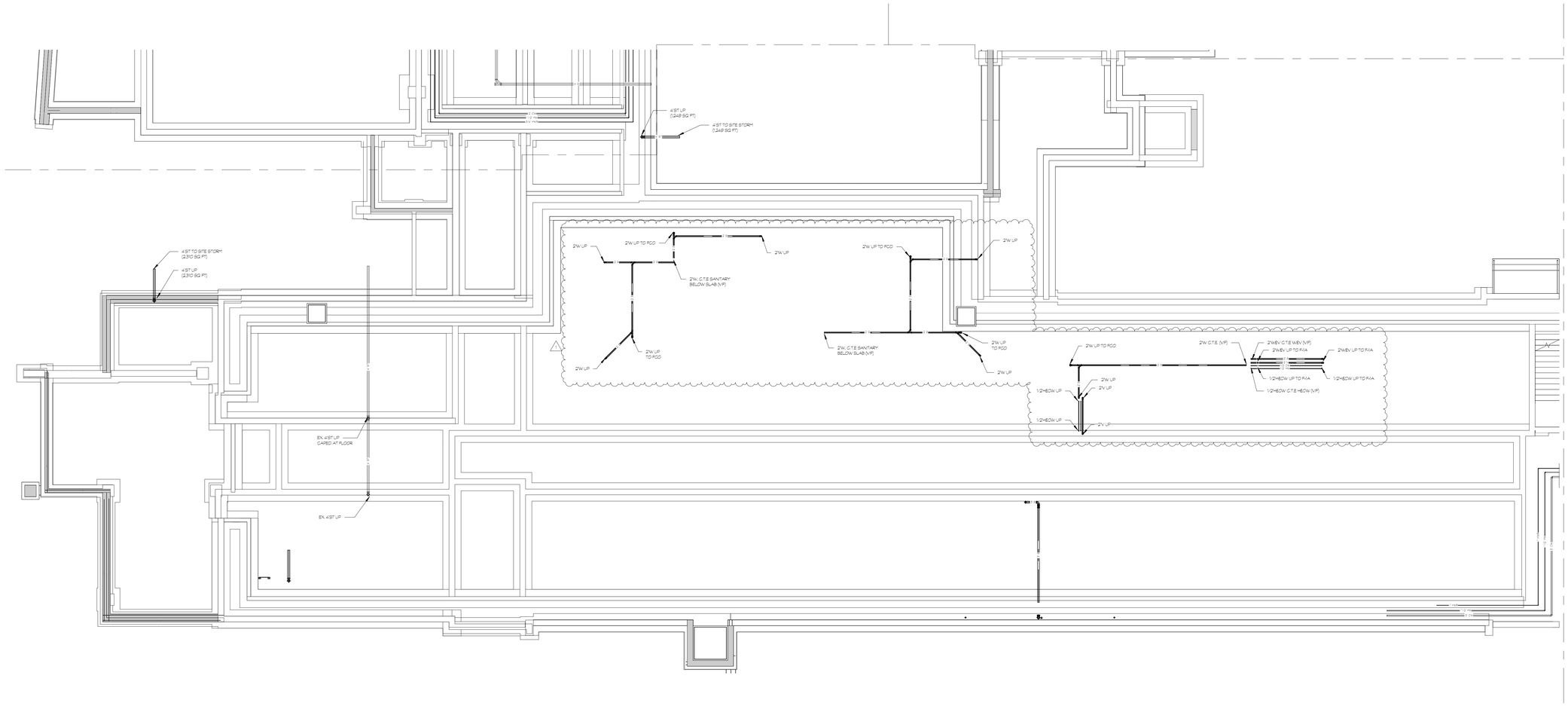
Revision:	Description:	Date:	Revised By:

Drawing Title:
MAIN LEVEL DEMO PLAN - AREA 'C'

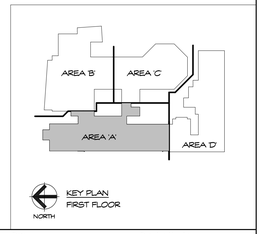
State Project Number: TMP-084-JLGB

Date: 8/18/2016
Scale: 1/8 =1'-0'
Drawn By: ARC
Project Number: 14.218

Drawing Number: P113



1 Tunnel Plumbing Plan - Area 'A'
P201 SCALE: 1/8" = 1'-0"



Project Title:

Expansion and Alterations to:

WEST SHORE MIDDLE SCHOOL

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1	ADDENDUM #1	11/1/2018	ARC

Revision:	Description:	Date:	Revised By:

Drawing Title:

TUNNEL PLUMBING PLAN - AREA 'A'

State Project Number: TMP-084-JLGB

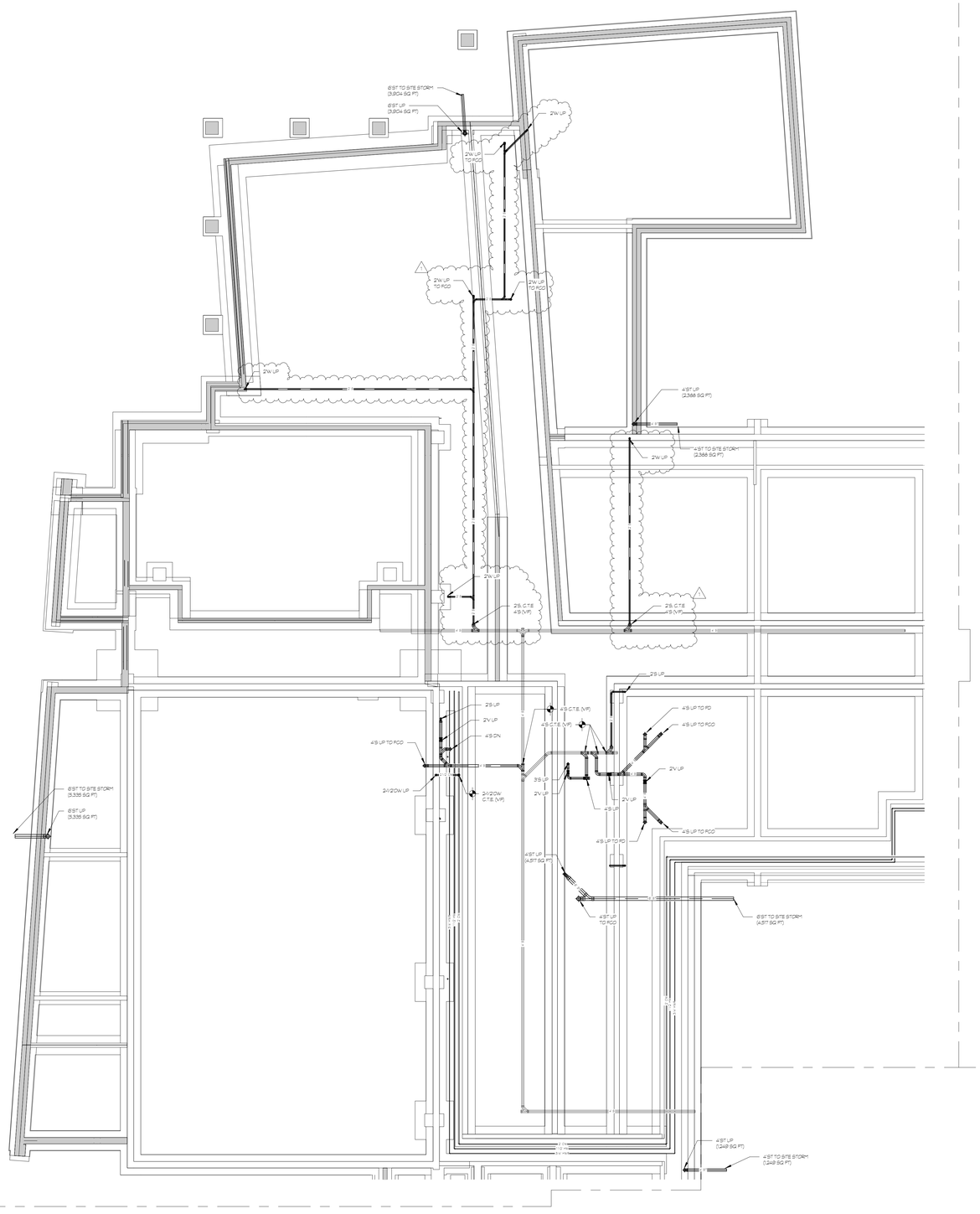
Date: 8/18/2018

Scale: 1/8" = 1'-0"

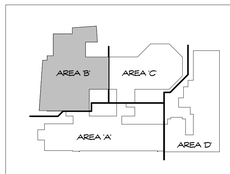
Drawn By: ARC

Project Number: 14.278

Drawing Number: P201



1 P202 Tunnel Plumbing Plan - Area 'B'
SCALE: 1/8" = 1'-0"



NORTH KEY PLAN

Project Title:

Expansion and Alterations to:

WEST SHORE MIDDLE SCHOOL

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Revision:	Description:	Date:	Revised By:
1	ADDENDUM #1	1/1/2016	ARC

Revision:	Description:	Date:	Revised By:

Drawing Title:

TUNNEL PLUMBING PLAN - AREA 'B'

State Project Number: TMP-084-JLGB

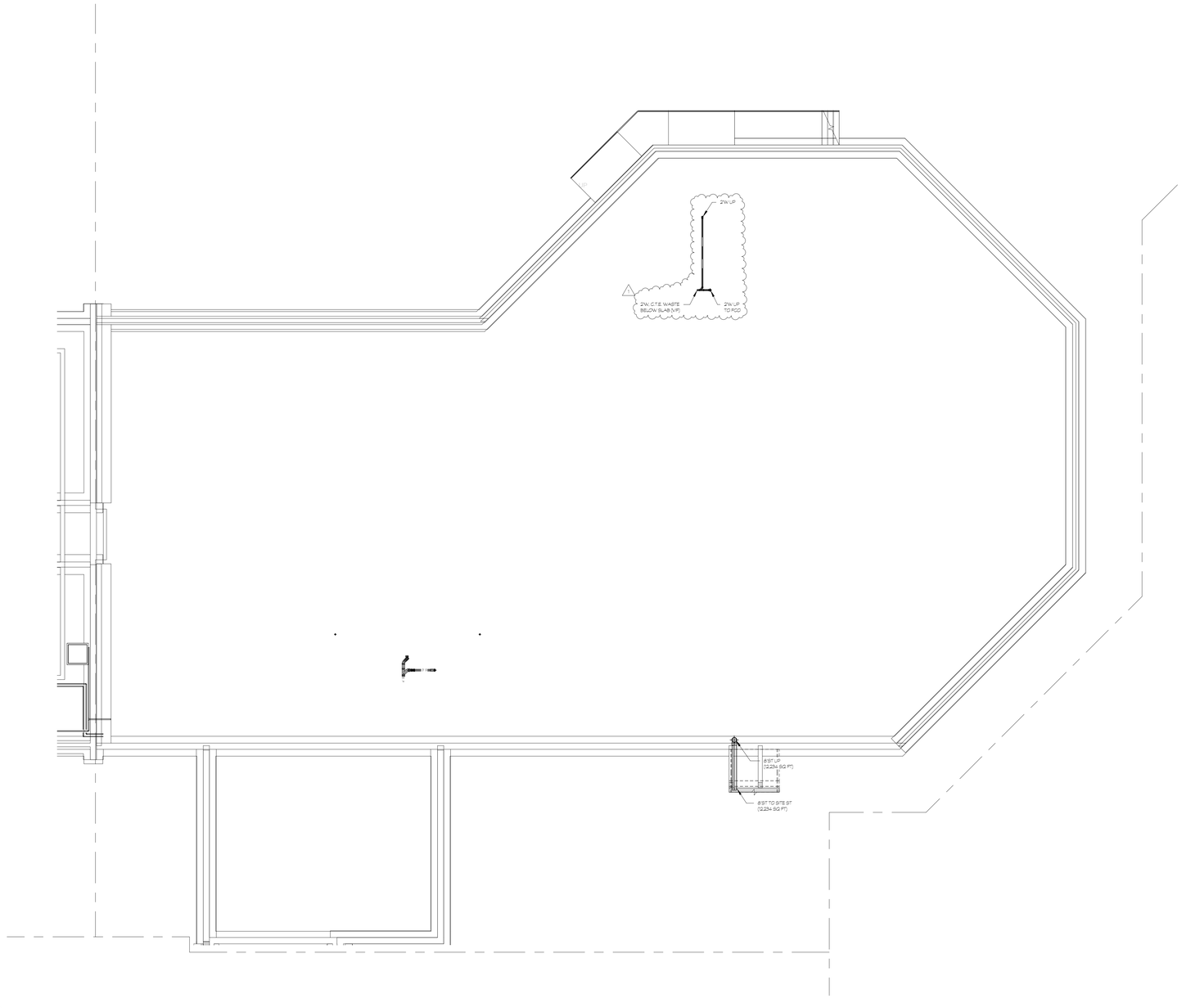
Date: 8/18/2016

Scale: 1/8" = 1'-0"

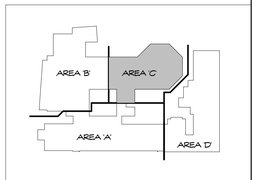
Drawn By: ARC

Project Number: 14-278

Drawing Number: P202



1 / P203 Tunnel Plumbing Plan - Area 'C'
SCALE: 1/8 = 1'-0"



NORTH
KEY PLAN
FIRST FLOOR

Project Title:

Expansion and Alterations to:

WEST SHORE MIDDLE SCHOOL

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1	ADDENDUM #1	1/1/2018	ARC

Revision:	Description:	Date:	Revised By:

Drawing Title:

TUNNEL PLUMBING PLAN - AREA 'C'

State Project Number: TMP-084-JLGB

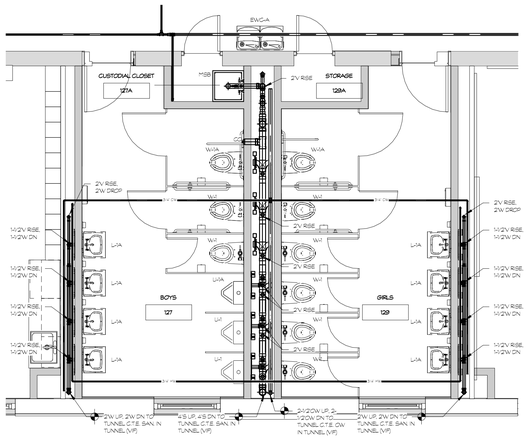
Date: 8/18/2016

Scale: 1/8 = 1'-0"

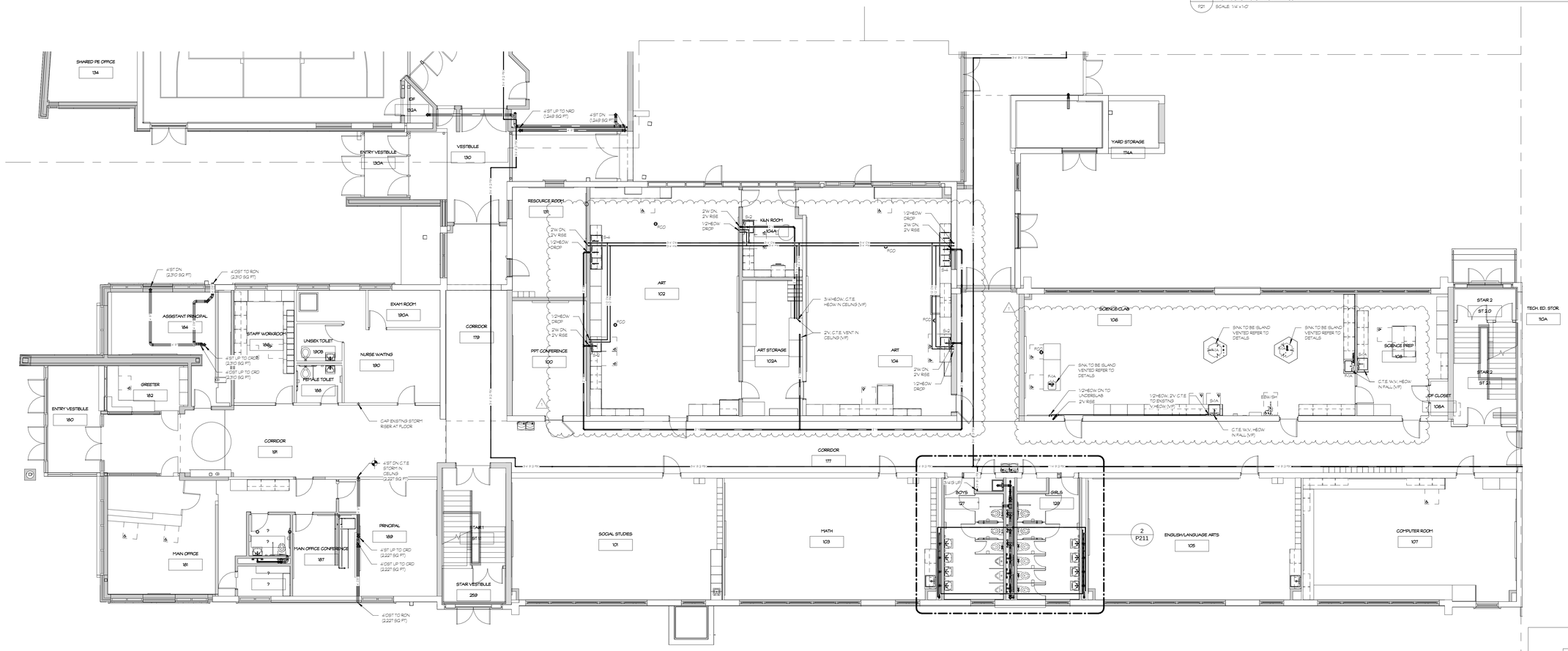
Drawn By: ARC

Project Number: 14.278

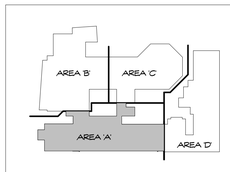
Drawing Number: P203



2 P211 Main Level Toilet Plan - Area 'A'
SCALE 1/4"=1'-0"



1 P211 Main Level Plumbing Plan - Area 'A'
SCALE 1/8"=1'-0"



NORTH KEY PLAN FIRST FLOOR

Project Title:

Expansion and Alterations to:

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Revision:	Description:	Date:	Revised By:
1	ADDENDUM #1	1/1/2016	ARC

Revision:	Description:	Date:	Revised By:

Drawing Title:

MAIN LEVEL PLUMBING PLAN - AREA 'A'

State Project Number: TMP-084-JLGB

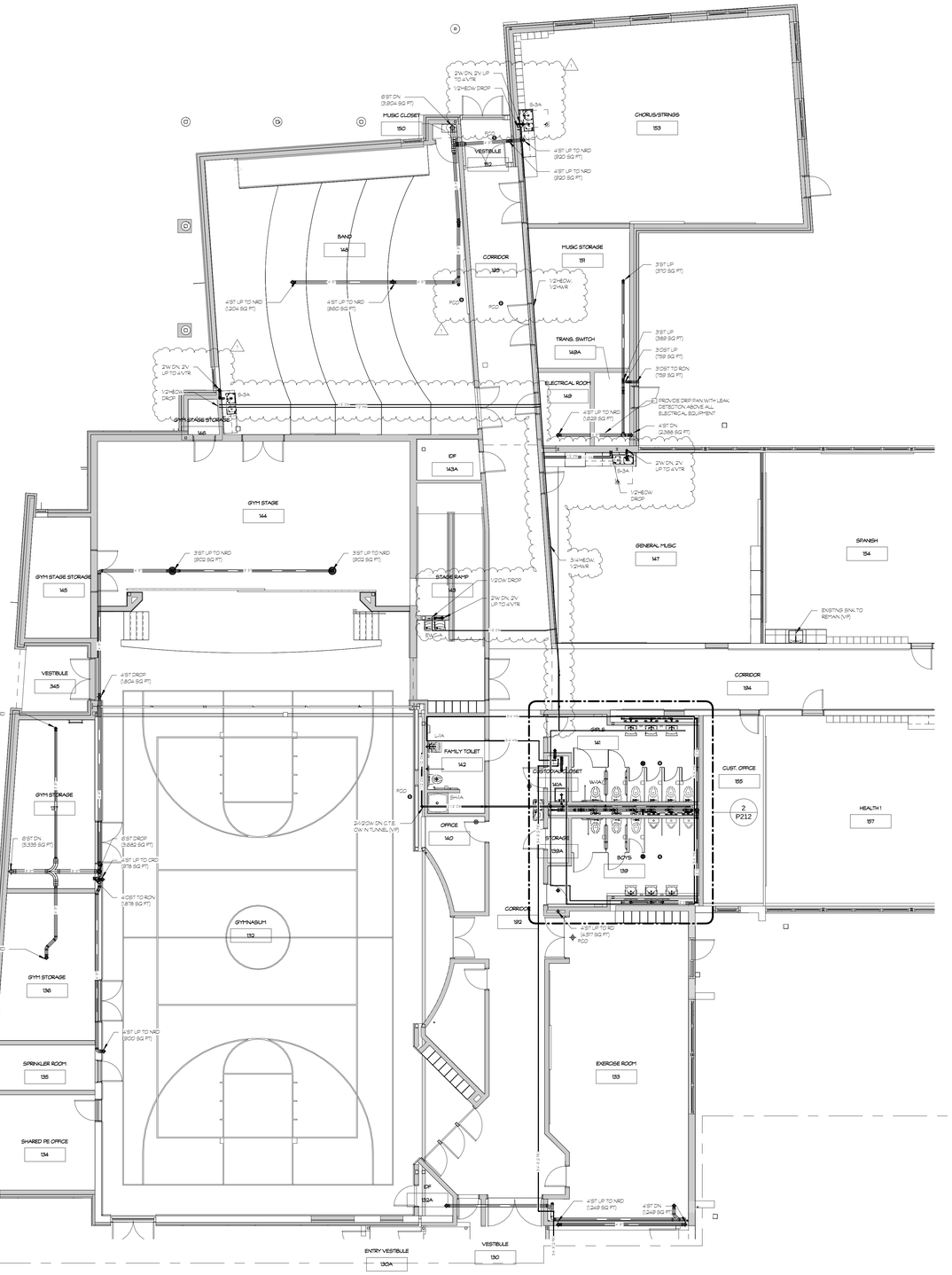
Date: 8/18/2016

Scale: As indicated

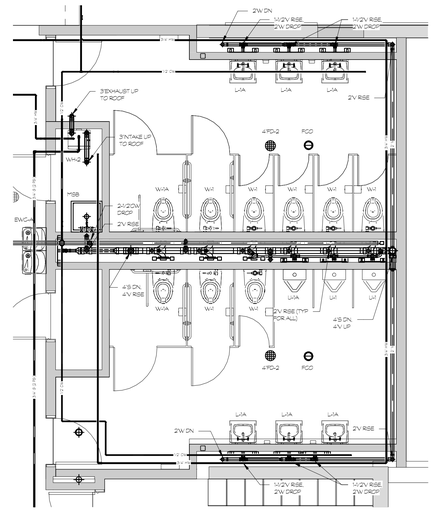
Drawn By: ARC

Project Number: 14.278

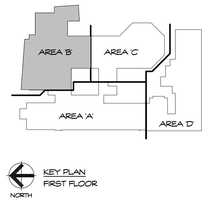
Drawing Number: P211



1 / P22 Main Level Plumbing Plan - Area 'B'
SCALE: 1/8"=1'-0"



2 / P22 Main Level Toilet Plan - Area 'B'
SCALE: 1/4"=1'-0"



Project Title:

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Revision:	Description:	Date:	Revised By:
1	ADDENDUM #1	11/1/2018	ARC

Revision:	Description:	Date:	Revised By:

Drawing Title:

MAIN LEVEL PLUMBING PLAN - AREA 'B'

State Project Number: TMP-084-JLGB

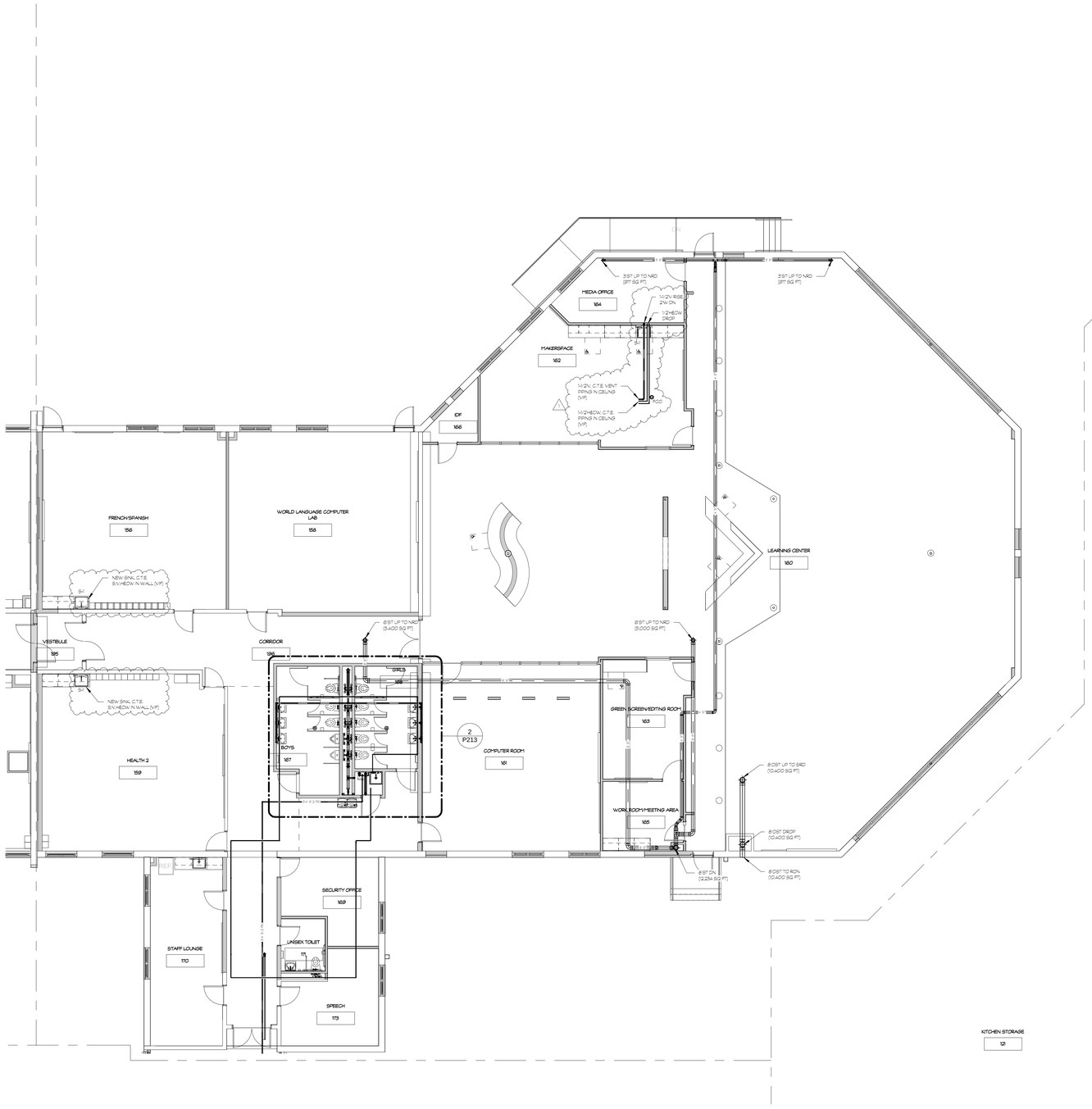
Date: 8/18/2018

Scale: As indicated

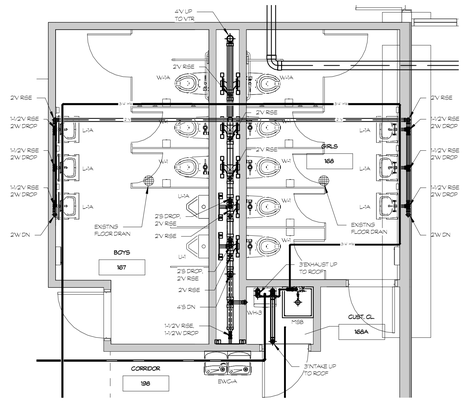
Drawn By: ARC

Project Number: 14-278

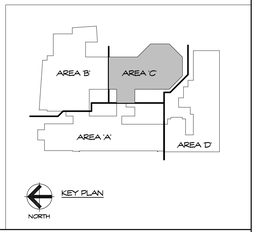
Drawing Number: P212



1 P213 Main Level Plumbing Plan - Area 'C'
SCALE: 1/8"=1'-0"



2 P213 Main Level Toilet Plan - Area 'C'
SCALE: 1/4"=1'-0"



Project Title:

Expansion and Alterations to:

WEST SHORE MIDDLE SCHOOL

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Revision:	Description:	Date:	Revised By:
1	ADDENDUM #1	11/1/2016	ARC

Revision:	Description:	Date:	Revised By:

Drawing Title:

MAIN LEVEL PLUMBING PLAN - AREA 'C'

State Project Number: TMP-084-JLGB

Date: 8/18/2016

Scale: As indicated

Drawn By: ARC

Project Number: 14.278

Drawing Number: P213

DRAIN SCHEDULE

MARK	FIXTURE, MODEL NUMBER AND DESCRIPTION	ROUGH-IN		
		TRAP	WASTE	VENT
FD-1	FLOOR DRAIN (MECHANICAL ROOM). WATTS FD-320-Y, HEAVY DUTY CAST IRON BODY, BOTTOM OUTLET. 9" DIAMETER CAST IRON TOP, TRAP PRIMER CONNECTION, SEEPAGE PAN AND COMBINATION MEMBRANE FLASHING CLAMP	AS NOTED ON DRWGS.	AS NOTED ON DRWGS.	AS NOTED ON DRWGS.
FD-2	FLOOR DRAIN (TOILET ROOM). WATTS FD-1100-A5, HEAVY DUTY CAST IRON BODY, BOTTOM OUTLET. 6"X6" SQUARE NICKEL BRONZE TOP, TRAP PRIMER CONNECTION, SEEPAGE PAN AND COMBINATION MEMBRANE FLASHING CLAMP	AS NOTED ON DRWGS.	AS NOTED ON DRWGS.	AS NOTED ON DRWGS.
FD-3	SHOWER DRAIN (SHOWER ENCLOSURE). WATTS FD-100-A5-7, HEAVY DUTY CAST IRON BODY, BOTTOM OUTLET. 5" DIAMETER NICKELBRONZE TOP, TRAP PRIMER CONNECTION, SEEPAGE PAN AND COMBINATION MEMBRANE FLASHING CLAMP	AS NOTED ON DRWGS.	AS NOTED ON DRWGS.	AS NOTED ON DRWGS.
FD-5	FLOOR SINK (KITCHEN AND ART ROOMS). WATTS FS-790-FC-5-6-150, 14 GAUGE 304 STAINLESS STEEL, BOTTOM OUTLET. 12"X12"X8" DEEP, CAST STAINLESS STEEL GRATE, DOME BOTTOM STRAINER, SEEPAGE PAN AND COMBINATION MEMBRANE FLASHING CLAMP STAINLESS STEEL SEDIMENT BUCKET, 1/2 GRATE FOR INDIRECT WASTE	AS NOTED ON DRWGS.	AS NOTED ON DRWGS.	AS NOTED ON DRWGS.
NRD	ROOF DRAIN. FROET 200C SERIES, HEAVY DUTY DRAIN WITH 14" - 18" DIAMETER CAST IRON BODY, BOTTOM OUTLET, CAST IRON DOME, ROOF SUMP RECEIVER, UNDER DECK CLAMP, ("NOTE: INCLUDE EXTENSION COLLAR AS REQUIRED FOR INSULATION OF CONSTRUCTION THICKNESS) EXTENSION, AND COMBINATION MEMBRANE FLASHING CLAMP/GRAVEL GUARD.	AS NOTED ON DRWGS.	AS NOTED ON DRWGS.	AS NOTED ON DRWGS.
SRD	OVERFLOW ROOF DRAIN. FROET 200C-WD2 SERIES, HEAVY DUTY DRAIN WITH 14" - 18" DIAMETER CAST IRON BODY, BOTTOM OUTLET, CAST IRON DOME, ROOF SUMP RECEIVER, UNDER DECK CLAMP, ("NOTE: INCLUDE EXTENSION COLLAR AS REQUIRED FOR INSULATION OF CONSTRUCTION THICKNESS) EXTENSION, AND COMBINATION MEMBRANE FLASHING CLAMP/GRAVEL GUARD.	AS NOTED ON DRWGS.	AS NOTED ON DRWGS.	AS NOTED ON DRWGS.
CRD	ROOF DRAIN (WITH OVERFLOW). FROET 100C SERIES, HEAVY DUTY BI-FUNCTIONAL DRAIN WITH 15" DIAMETER CAST IRON BODY, BOTTOM OUTLET, 12" DIAMETER CAST IRON DOME, ROOF SUMP RECEIVER, UNDER DECK CLAMP, ("NOTE: INCLUDE EXTENSION COLLAR AS REQUIRED FOR INSULATION OF CONSTRUCTION THICKNESS) EXTENSION, AND COMBINATION MEMBRANE FLASHING CLAMP/GRAVEL GUARD.	AS NOTED ON DRWGS.	AS NOTED ON DRWGS.	AS NOTED ON DRWGS.
RON	WATTS RD-940-83 THREADED INLET, FITTING EQUIPPED WITH ANCHOR FLANGE, PRE-DRILLED COUNTER SUNK MOUNTING HOLES, STAINLESS STEEL BIRD SCREEN. NICKEL BRONZE BODY. COORDINATE SIZING WITH OVERFLOW DRAINAGE. REFER TO DRAWINGS.	NA	AS NOTED ON DRWGS.	NA

NOTES:
1. PROVIDE TRAP PRIMERS FOR ALL DRAINS. DRAINS INCORPORATING A CONSTANT AND REGULAR WASTE ARE NOT REQUIRED TO INTERGRATE TRAP PRIMERS (I.E. SHOWER DRAINS, KITCHEN DRAINS, ETC).
2.TRANSITION COUPLINGS AND NO-HUB PIPE SHALL NOT BE INSTALLED BELOW SLAB OR IN ANY BURIED CONDITIONS IN CONTACT WITH EARTH

CLEANOUT SCHEDULE

MARK	FIXTURE, MODEL NUMBER AND DESCRIPTION	TRAP SIZE	REMARKS
FCO	FLOOR CLEANOUT (ALL INTERIOR AREAS EXCEPT CARPETED AREAS). WATTS CO-200-RX-C-6, ADJUSTABLE ROUND SCORIATED HEAVY DUTY NICKEL BRONZE SECURED TOP WITH FRAME, CAST IRON BODY, FLASHING FLANGE AND CLAMP, BRONZE PLUG. PROVIDE WITH VANDAL PROOF SCREWS. PROVIDE NICKEL BRONZE FRAME IN WET AREAS.	AS NOTED ON DWG.	--
FCO	FLOOR CLEANOUT (CARPETED AREAS). WATTS CO-200-RC-6, ADJUSTABLE ROUND SCORIATED HEAVY DUTY NICKEL BRONZE SECURED TOP WITH FRAME, CARPET MARKER, CAST IRON BODY, FLASHING FLANGE AND CLAMP, BRONZE PLUG. PROVIDE WITH VANDAL PROOF SCREWS.	AS NOTED ON DWG.	--
YCO	FLOOR CLEANOUT (EXTERIOR AREAS). WATTS CO-300-MF-6 WITH CO-380 ROUND FLANGED HOUSING WITH HEAVY DUTY SCORIATED DUCTILE IRON TOP, CLEANOUT FERRULE BODY WITH BRONZE PLUG. INSTALL CLEANOUTS WITH 18"SQUARE X 6" DEEP CONCRETE APRON IN NON-PAVED AREAS. PROVIDE WITH VANDAL PROOF SCREWS.	AS NOTED ON DWG.	--
WCO	WALL PLATE CLEANOUT COVER. WATTS CO-590-RD, PROVIDE AT CAST IRON CLEANOUTS WITH COUNTERSUNK BRASS PLUG AND STAINLESS STEEL COVER SECURED WITH VANDAL PROOF SCREWS.	--	--

NOTES:
1. TRANSITION COUPLINGS AND NO-HUB PIPE SHALL NOT BE INSTALLED BELOW SLAB OR IN ANY BURIED CONDITIONS IN CONTACT WITH EARTH

2. PROVIDE ALL POURED IN PLACE CLEANOUTS WITH 24"X24" FLASHING

BACKFLOW PREVENTER SCHEDULE

MARK	SIZE	LOCATION	SERVICE	BODY MATERIAL	TEMPERATURE RANGE	MAX. WORKING PRESSURE	MANUFACTURER / MODEL	REMARKS
BFP-1	1-1/2"	EXISTING BOILER ROOM	BOILER MAKE-UP WATER	BRONZE	33°F-140°F	175PSI	WATTS / SERIES LF909	LEAD FREE, WITH INTEGRAL RELIEF VALVE MONITOR SWITCH, PROVIDE WITH SOLENOID VALVE (ASCO 8210)

INSULATION SCHEDULE

SYSTEM	PIPE SIZE	INSULATION TYPE	INSULATION THICKNESS	FITTINGS, VALVES, FLANGES INSULATION TYPE	REMARKS
DOMESTIC COLD WATER	ALL	MINERAL FIBER, ASJ, SSL	1"	MOLDED, PRE-FORMED MINERAL FIBER WITH PVC JACKET	TYPE 1
DOMESTIC HOT WATER & HWC	< 1-1/2"	MINERAL FIBER, ASJ, SSL	1"	MOLDED, PRE-FORMED MINERAL FIBER WITH PVC JACKET	TYPE 1
DOMESTIC HOT WATER & HWC	> 1-1/2"	MINERAL FIBER, ASJ, SSL	1"	MOLDED, PRE-FORMED MINERAL FIBER WITH PVC JACKET	TYPE 1
DOMESTIC WATER UNDERGROUND & INSLAB	ALL	CLOSED CELL	1"	ARMAFLEX	--
CONDENSATE	ALL	MINERAL FIBER, ASJ, SSL	1/2"	MOLDED, PRE-FORMED MINERAL FIBER WITH PVC JACKET	TYPE 1
INTERIOR ROOF DRAIN PIPING	ALL	MINERAL FIBER, ASJ, SSL	1"	MOLDED, PRE-FORMED MINERAL FIBER WITH PVC JACKET	TYPE 1 INCLUDE ROOF DRAIN BODY
FLOOR DRAIN TRAP IN MECHANICAL ROOM	ALL	MINERAL FIBER, ASJ, SSL	1"	MOLDED, PRE-FORMED MINERAL FIBER WITH PVC JACKET	TYPE 1 INCLUDE 8' HORIZONTAL RUN
EXTERIOR PIPE	ALL	CELLULAR GLASS (FOAM GLASS)	2"	CELLULAR GLASS (FOAM GLASS)	ALUMINUM JACKET WITH FREEZE PROTECTION HEAT TRACE

NOTES:
1. FIBERGLASS INSULATION: THERMAL CONDUCTIVITY .22 TO .28 BTU x IN./H x FT x °F W/ 100°F MEAN TEMP. THICKNESS BASED ON ASHRAE 90.1, 2007 6.8.3

2. REFER TO SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS

3. ALL KITCHEN WASTE SHALL BE HEAT TRACED FROM FIXTURE TO THE GREASE INTERCEPTOR

4. FOR ITEMS INSTALLED IN PLENUM RATED CEILING, MATERIALS SHALL COMPLY WITH ASTM E 84 WITH FLAME-SPREAD INDEX OF 25 OR LESS, AND SMOKE-DEVELOPED INDEX OF 50 OR LESS.

5. FIRE-BARRIER PENETRATIONS: MAINTAIN INDICATED FIRE RATING OF WALLS, PARTITIONS, CEILINGS, AND FLOORS AT PIPE PENETRATIONS, REFER TO ARCHITECTURAL PLANS FOR LOCATIONS. SEAL PIPE PENETRATIONS WITH FIRESTOP MATERIALS, REFER TO SPECIFICATIONS FOR ADDITIONAL INFORMATION

PIPE AND FITTING SCHEDULE

DESCRIPTION	SIZE	PIPE		FITTING		REMARKS
		TYPE	SCHEDULE	TYPE	RATING	
SOIL, WASTE AND VENT ABOVE GROUND	ALL	CI-NH / PVC	SV / 40	CI / PVC	SV / 40	4 BAND FOR 4" AND SMALLER 6 BAND FOR LARGER THEN 4"
SOIL, WASTE AND VENT BELOW GROUND	ALL	CI-H&S / PVC	SV / 40	CI / PVC	SV / 40	--
STORM ABOVE GROUND	ALL	CI-NH / PVC	SV / 40	CI / PVC	SV / 40	4 BAND FOR 4" AND SMALLER 6 BAND FOR LARGER THEN 4"
STORM BELOW GROUND	ALL	CI-H&S / PVC	SV / 40	CI / PVC	SV / 40	--
HOT, COLD & RECIRC. WATER IN BUILDING	2" AND SMALLER	FOSTAPEX	--	PEX FITTINGS	--	FORM STABLE PEX
HOT & COLD WATER IN BUILDING	2-1/2" AND LARGER	COPPER	TYPE L	CUS	STD	HARD TEMPERED
INDIRECT WASTE AND CONDENSATE PIPING	ALL	COPPER	TYPE L	CUS	STD	HARD TEMPERED
DOMESTIC HOT & COLD WATER PIPING WITHIN BUILDING, BELOW SLAB	ALL	COPPER	TYPE K	CUS	STD	SOFT TEMPERED, NO JOINTS BELOW SLAB
DOMESTIC WATER SERVICE PIPING	2-1/2" AND SMALLER	COPPER	TYPE K	CUS	STD	SOFT TEMPERED, NO JOINTS BELOW SLAB
DOMESTIC WATER SERVICE PIPING	3" AND LARGER	CLDI	CLASS 52	DIMJ	250	--
TRAP PRIMER PIPING	ALL	FOSTAPEX	--	PEX FITTINGS	--	NO JOINTS ALLOWED BELOW SLAB
GAS PIPING	2" AND SMALLER	STL-BLK	SCH. 40	MIT	CLASS 150	--
GAS PIPING	2-1/2" AND LARGER	STL-BLK	SCH. 40	WE	SCH. 40	--
FORCE MAIN (ABOVE GROUND)	2" AND SMALLER	COPPER	TYPE L	CUS	STD	--
FORCE MAIN (ABOVE GROUND)	2-1/2" AND LARGER	GS,GES	--	PF,TJ,GJ	--	--
FORCE MAIN (BELOW GROUND)	4" AND SMALER	DI	SV	DI	MJ	--

NOTES:
1. TRANSITION COUPLINGS AND NO-HUB PIPE SHALL NOT BE INSTALLED BELOW SLAB OR IN ANY BURIED CONDITIONS IN CONTACT WITH EARTH

2. ALL PIPING IN RETURN AIR CEILING PLENUM INSTALLATIONS SHALL BE UL LISTED FOR THIS APPLICATION

3. MECHANICAL JOINTS ARE ALLOWED FOR SERVICE PURPOSED ONLY IN WALLS AND CEILINGS BUT MUST BE READILY ACCESSIBLE. 25/50 PVDF IS UL LISTED FOR RETURN AIR CEILING PLENUM ISTALLATIONS

ABBREVIATIONS	DESCRIPTION	ABBREVIATIONS	DESCRIPTION
AWWA	AMERICAN WATER WORKS ASSOCATION	MIT	MALLEABLE IRON THREADED
CI	CAST IRON	NH	NO HUB W/SUPER DUTY HUSKY SD 4000 CLAMP
CLDI	CEMENT LINED DUCTILE IRON	PEX	PEX PIPING
CPVC	CHLORINATED POLYVINYL CHLORIDE	PF	PRESSURE FITTING
CUS	WROUGHT COPPER SOLDER (95/5)	PVDF	POLYVINYLIDENE FLUORIDE PIPING
DI	DUCTILE IRON	POLY-PRO	POLYPROPYLENE PIPING
DIMJ	DUCTILE IRON MECHANICAL JOINT	STD	STANDARD
GES	GROOVED END STEEL	STL-BLK	BLACK STEEL
GJ	GROOVED JOINT SYSTEM FITTINGS/COUPLINGS	SV	SERVICE WEIGHT
GS	GALVANIZED STEEL	TJ	THREADED JOINTS
H&S	HUB AND SPIGOT	WE	BUT WELD
MJ	MECHANICAL JOINT		

VALVE SCHEDULE

DESCRIPTION	SIZE	TYPE					CLASS	REMARKS
		GATE	CHECK	BALL	PLUG	BALANCE		
DOMESTIC COLD WATER	2" AND SMALLER	GVT	CVT	BVT	--	--	125PSI	--
DOMESTIC HOT WATER	2" AND SMALLER	GVT	CVT	BVT	--	CBV	125PSI	--
DOMESTIC COLD WATER	2-1/2" AND LARGER	GVF	CVF	--	--	--	125PSI	--
DOMESTIC HOT WATER	2-1/2" AND LARGER	GVF	CVF	--	--	CBV	125PSI	--
BACKFLOW PREVENTER	2" AND SMALLER	--	--	BVT	--	--	125PSI	--
BACKFLOW PREVENTER	2-1/2" AND LARGER	GVF	--	--	--	--	125PSI	--
GAS	2" AND SMALLER	--	--	--	PGVT	--	125PSI	--
GAS	2-1/2" AND LARGER	--	--	--	PGVF	--	125PSI	--

NOTES:
1. SOLENOID VALVE: UL LISTED, FM APPROVED FOR GAS SERVICE, EXPLOSION PROOF, TWO -WAY NORMALLY CLOSED. ASCO 8044 SERIES W/MANUAL RESET. (EMERGENCY GAS SHUT-OFF VALVE ASSEMBLY)

2. CALIBRATED PRESSURE RELIEF VALVE: INSTALL A MINIMUM OF 12" ABOVE WATER HEATER AND PIPE DISCHARGE TO ADEQUATE LOCATION. WATTS MODEL 540C

ABBREVIATION	DESCRIPTION	ABBREVIATION	DESCRIPTION
BVA	BALL VALVE COMPRESSED AIR - 3-PIECEI, FULL PORT, BRONZE	CVF	CHECK VALVE FLANGED - IMMB
BVF	BALL VALVE FLANGED - FULL PORT, BRONZE	CVT	CHECK VALVE THREADED - BRONZE
PGVT	PLUG VALVE THREADED - AGA APPROVED	GVF	GATE VALVE FLANGED - IMMB
BVT	BALL VALVE THREADED - 2-PIECE, FULL PORT, 400PSI, BRONZE	GVT	GATE VALVE THREADED - BRONZE
CBV	CALIBRATED BALANCING VALVE - BRONZE	PGVF	PLUG VALVE FLANGED - AGA APPROVED
CPRV	CALIBRATED PRESSURE RELIEF VALVE		

PLUMBING FIXTURE/EQUIPMENT SCHEDULE

MARK	FIXTURE, MODEL NUMBER AND DESCRIPTION	ROUGH-IN			
		WASTE/ SANITARY	VENT	CW	HW
W-1	WATER CLOSET, WALL HUNG, AMERICAN STANDARD AFWALL FLOWISE 2859.128, VITREOUS CHINA, ELONGATED BOWL, 1-1/2" TOP SPUD, SIPHON JET TOILET WITH WALL SUPPLY, 1.28 GPF MANUAL FLUSH VALVE. AMERICAN STANDARD 5901.100 OPEN FRONT SEAT. PROVIDE ALL ITEMS REQUIRED FOR COMPLETE INSTALLATION.	4"	2"	1"	--
W-1A	WATER CLOSET, A.D.A COMPLIANT, WALL HUNG, AMERICAN STANDARD AFWALL FLOWISE 2859.128, VITREOUS CHINA, ELONGATED BOWL, 1-1/2" TOP SPUD, SIPHON JET TOILET WITH WALL SUPPLY, 1.28 GPF MANUAL FLUSH VALVE. AMERICAN STANDARD 5901.100 OPEN FRONT SEAT. PROVIDE ALL ITEMS REQUIRED FOR COMPLETE INSTALLATION.	4"	2"	1"	--
U-1	URINAL, WALL HUNG, AMERICAN STANDARD WASHBROOK FLOWISE 6590.503, VITREOUS CHINA 3/4"INLET SPUD WALL SUPPLY WASHOUT URINAL WITH FULLY ENCLOSED P-TRAP. MANUAL FLUSH VALVE .125 GPF. PROVIDE ALL ITEMS REQUIRED FOR COMPLETE INSTALLATION.	2"	2"	3/4"	--
U-1A	URINAL, A.D.A COMPLIANT, WALL HUNG, AMERICAN STANDARD WASHBROOK FLOWISE 6590.503, VITREOUS CHINA 3/4"INLET SPUD WALL SUPPLY WASHOUT URINAL WITH FULLY ENCLOSED P-TRAP. MANUAL FLUSH VALVE .125 GPF. PROVIDE ALL ITEMS REQUIRED FOR COMPLETE INSTALLATION.	2"	2"	3/4"	--
L-1A	LAVATORY, WALL HUNG, AMERICAN STANDARD LUCERNE 355.012 VITREOUS CHINA , AMERICAN STANDARD RELIANT3 7385LH.003 SINGLE " HANDLE FAUCET, 0.5 GPM. 1-1/2" CHROME PLATED CAST BRASS P-TRAP , SUPPLIES, BRASS ANGLE STOPS WITH LOOSE KEY OPERATION, GRID DRAIN, ETC. FOR COMPLETE INSTALLATION. COORDINATE MOUNTING HEIGHTS WITH ARCHITECT PRIOR TO INSTALLATION.	2"	1-1/2"	1/2"	1/2"
SH-1A	SHOWER ASSEMBLY, SHOWER ENCLOSURE: AQUATIC 1363BFSD, 36"X36" SHOWER UNIT WITH DRAIN FITTING. SHOWER SYSTEM WITH HAND SHOWER : ACORN CONTROLS MODEL SV16-LVR-SH15-BA-HHC15-HHSH-HHWB-DIV-IVB-HHSE, PRESSURE BALANCING SHOWER VALVE WITH LEVER HANDLE, INTEGRAL CHECK STOPS & VOLUME CONTROL, CHROME PLATED, VANDAL PROOF, TYPE FD-3 SHOWER DRAIN, COORDINATE LEFT/RIGHT HAND UNITS WITH ARCHITECTURAL DRAWINGS. PROVIDE 36" SLIDE BAR, BENCH AND ALL REQUIRED HANDRAILS. COORDINATE WITH ARCHITECTURAL DRAWINGS.	3"	2"	3/4"	3/4"
EWC-A	ELECTRIC WATER COOLER W/BOTTLE FILLING STATION, ADA COMPLIANT, ELKAY EZSTLG8WSSK W/APRON ELKAY LKAPREZL, A.D.A. COMPLIANT WHEN PROPERLY INSTALLED, A.D.A. COMPLIANT CONTROLS, FRONT PUSH BAR CONTROLS, (FRONT MOUNT PUSH BUTTON SHALL BE OPERABLE WITH A 5 LB. MAXIMUM FORCE), ELECTRICAL RATING; 115 VOLTS, 60HZ RATED WATTS:360, FULL LOAD AMPS:4.2, MINIMUM COOLING CAPACITY: 8 GPH	2"	1-1/2"	1/2"	--
MSB	MOP SINK, FIAT MSB2424, MOLDED STONE, 24x24x12, SERVICE FAUCET PLATE #830-AA, HOSE AND HOSE BRACKET PLATE #832- AA, BUMPER GUARD PLATE #E-77-AA, SS MOP HANGER #889-CC, MOP SINK DRAIN GASKET #QDC3XH, WALL GUARDS #MSG24, WITH INTEGRAL DRAIN. PROVIDE THREADED HOSE BIBB CONNECTION FOR CHEMICAL FEED SYSTEM AS REQUIRED (SEE DETAIL). PROVIDE TRAP, SUPPLIES, STOPS, ETC FOR COMPLETE INSTALLATION.	3"	2"	3/4"	3/4"
S-1A	SINGLE BOWL SINK: ADA COMPLIANT, ELKAY LRAD-2521, 25 X 21 X 6, 18 GAUGE TYPE 302 STAINLESS STEEL, SELF-RIMMING. FAUCET: DELTA 711LF-HDF (LEAD FREE) 1.5 GPM, SINGLE LEVER SWING SPOUT FAUCET LESS SPRAY. PROVIDE 1/2" CHROME PLATED CAST BRASS P-TRAP , SUPPLIES, BRASS ANGLE STOPS WITH LOOSE KEY OPERATION, GRID DRAIN, ETC. FOR COMPLETE INSTALLATION.	1-1/2"	1-1/2"	1/2"	1/2"
S-2	PLASTER SINK, KOHLER K-12784, 24X22-1/8X8-5/8", VITREOUS CHINA, LESS CENTERSET HOLE FOR FAUCET IF AVAILABLE FROM MANUFACTURER. FAUCET: T&S BRASS B-0665-BSTP W/BWH4 (WRIST BLADES) WITH THREADED OUTLET, PROVIDE 2.2 GPM FLOW RESTRICTOR, PAIL HOOK, WALL BRACE AND INTEGRAL VACUUM BREAKER. COORDINATE MOUNTING HEIGHT OF FAUCET WITH OWNER. PROVIDE CLAY TRAP , SUPPLIES, BRASS ANGLE STOPS WITH LOOSE KEY OPERATION, GRID DRAIN, ETC. FOR COMPLETE INSTALLATION.	1-1/2"	1-1/2"	3/4"	3/4"
S-3A	CLASSROOM SINK WITH DRINKING FOUNTAIN, ADA COMPLIANT, ELKAY DRKAD371755(L/R) FOR RIGHT OR LEFT HAND USE. PROVIDE WITH 5" BOWL DEPTH AND DRAIN OFFSET TO REAR. PROVIDE WITH SWING SPOUT FAUCET WITH WRIST BLADES, MODEL LKD2439BHC AND REMOTE CONTROLLED FLEXIGUARD BUBBLER MODEL LKR1141A. PUSHBUTTON SHALL BE LOCATED IN FRONT FACE OF COUNTER IN ACCESSIBLE LOCATION. PROVIDE TRAP, SUPPLIES, STOPS, ETC FOR COMPLETE INSTALLATION.	1-1/2"	1-1/2"	1/2"	1/2"
S-4	THREE COMPARTMENT SCULLERY SINK, ADVANCE TABCO BSR-72. FAUCET: T&S BRASS B-0230-132XA-CR, PROVIDE 1.5 GPM FLOW RESTRICTOR, WALL MOUNTED MIXING FAUCET WITH 4" WRIST BLADE HANDLES. PROVIDE CLAY TRAP, SUPPLIES, BRASS ANGLE STOPS WITH LOOSE KEY OPERATION, GRID DRAIN, ETC. FOR COMPLETE INSTALLATION.	1-1/2"	1-1/2"	1/2"	1/2"
F-1A	LABORATORY SINK: ADA COMPLIANT, REFER TO ARCHITECT FOR SINK, FAUCET:T&S BRASS BL-5704-08-VR W/BWH4 (WRIST BLADES) & 71X, RIGID VACUUM BREAKER GOOSE NECK, PROVIDE 1.5 GPM FLOW RESTRICTOR, 1/2" THREADED HOT AND COLD WATER INLET, SERRATED HOSE TIP, HOT AND COLD WATER INDEX BUTTON, ANTI-ROTATION BODY. FAUCET SPOUT TO BE FIELD ASSEMBLED AT 90° IN ACCORDANCE WITH MANUFACTURERS REQUIREMENTS. PROVIDE IPEX W311 SINK OUTLET WITH INTEGRAL STRAINER.	1-1/2"	1-1/2"	1/2"	1/2"
NT-1 & NT-2	ACID NEUTRALIZATION/DILUTION TANK	--	--	--	--
ST-1	ACID NEUTRALIZATION/SAMPLING SUMP TANK	--	--	--	--
EEW/SH	EMERGENCY EYE/FACE WASH SHOWER ASSEMBLY: BRADLEY S19314CA2ABEA00, A.D.A. COMPLIANT, ANSI CERTIFIED, COMBINATION EYEWASH AND SHOWER. WATER SUPPLY EQUIPPED WITH A THERMOSTATIC MIXING VALVE TO DELIVER TEMPERED WATER (SEE SCHEDULE). FIXTURE TO BE ORDERED WITH 24" DRAIN HEIGHT, PLASTIC SHOWERHEAD LESS SHROUD, HALO EYE/FACE WASH, 304 STAINLESS STEEL BOWL, COVER AND HANDLE. PROVIDE VACUUM BREAKER ON INLET TO FIXTURE. PROVIDE WITH PRIVACY CURTAIN S19-330.				
HB	HOSE BIBB (UNFINISHED AREAS), WOODFORD MODEL 24, BRONZE BODY, REMOVABLE VALVE SEAT & STEM ASSEMBLY, THREADED END, INTEGRAL VACUUM BREAKER.	--	--	3/4"	--
FPHB	FREEZE PROOF HOSE BIBB, WOODFORD MODEL MB67, CAST BRONZE NON-FREEZE WALL HYDRANT WITH STAINLESS STEEL HINGED LOCKING COVER, 3/4"HPT OUTLETS, INTEGRAL DOUBLE CHECK BACKFLOW PREVENTER PRESSURE RELIEF VALVE, AND 3/4" FEMALE & 1" MALE NPT INLER CONNECTION	--	--	3/4"	--
SA	WATER HAMMER ARRESTOR, PRECISION PLUMBING PRODUCTS (PPP.) SC SERIES, 1/2"-1", SIZE PER MANUFACTURER RECOMMENDATIONS AND REQUIREMENTS	--	--	1/2"-1"	--
TP	ELECTRIC TRAP PRIMER, PRECISION PLUMBING PRODUCTS (PPP.) PT SERIES, CONSISTING OF CIRCUIT BREAKER (MIN. 2 AMP), SWITCH TIMER, SOLENOID VALVE, ANTI-SIPHON ATMOSPHERIC VACUUM BREAKER, 120V, SINGLE PHASE. SURFACE OR RECESSED CABINET BASED ON WALL CONDITIONS (REFER TO DWGS.) COORDINATE ACCESS PANEL FINISH WITH ARCHITECT. COORDINATE NUMBER OF OUTLETS AS REQUIRED BY QUANTITY OF DRAINS. INSTALL PER MANUFACTURER'S REQUIREMENTS AND RECOMMENDATIONS	--	--	3/4"	--
WT	WASHER TRIM, PRECISION PLUMBING PRODUCTS MM-500 MLB, 20 GAUGE STEEL LAUNDRY BOX WITH WHITE POWDER COAT FINISH, QUARTER TURN BALL VALVES & INTEGRAL WATER HAMMER ARRESTORS				

NOTES:
1. LAVATORY & WATER COOLERS SUPPLY SHALL BE BRASS W/ BRASS ANGLE STOPS FOR 1/2" WATER SUPPLY LINES, W/ LOOSE KEY (W/CAP), AND WALL FLANGE. ALL COMPONENTS SHALL BE POLISHED CHROME FINISH. MANUFACTURER: BRASS CRAFT OR APPROVED EQUAL.

2. CAST BODY "P" TRAP 1-1/2" x 1-1/2" WITH HEAVY CAST J-BEND & FLAT CLEANOUT PLUG, SLIP NUTS AND WALL FLANGE. ALL COMPONENTS SHALL BE POLISHED CHROME FINISH. MANUFACTURER: BRASS CRAFT OR APPROVED EQUAL.

3. STRAINERS SHALL BE FURNISHED WITH FIXTURES AS REQUIRED. FOR H/C LAVATORY OR SINKS PROVIDE OFFSET TAILPIECE.

4. PROVIDE TRUEBRO MODEL 103 (WHITE), ANTIMICROBAL HANDI LAV-GUARDS INSTALLATION KIT FOR ALL WHEELCHAIR LAVATORY & SINKS FOR WATER SUPPLIES & WASTE LINE.

5. PROVIDE WATER SUPPLY & "P" TRAP & OPTIONAL WATER FILTERS FOR ELECTRIC WATER COOLERS AS PER MANUFACTURERS RECOMMENDATIONS.

6. THE PLUMBING FIXTURES VENDOR SHALL COORDINATE WITH THE PLUMBING AND GENERAL CONTRACTOR ALL PLUMBING FIXTURES ROUGH IN DIMENSIONS BEFORE CONSTRUCTION BEGIN.

7. UNLESS SHOWN ABOVE, PLUMBING FIXTURES MANUFACTURER, TRIM COLOR AND FINISH SHALL BE FURNISHED AS DIRECTED BY OWNER/ARCHITECT.

8. REFER TO ARCHITECTURAL DRAWINGS FOR STANDARD, A.D.A MOUNTING AND CHILD HEIGHTS. REFER TO ARCHITECTURAL FOR LOCATION OF A.D.A COMPLIANT SHOWER SEAT AND SHOWER BARS

9. CONTRACTOR TO PROVIDE AN EXTRA 10% OF AERATORS, CARTRIDGE, ETC...

Project Title:
Expansion and Alterations to:
WEST SHORE MIDDLE SCHOOL
70 Kay Avenue, Milford, CT 06460

SILVER / PETRUCELLI + ASSOCIATES
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3190 Whitney Avenue, Hamden, CT 06518-2340
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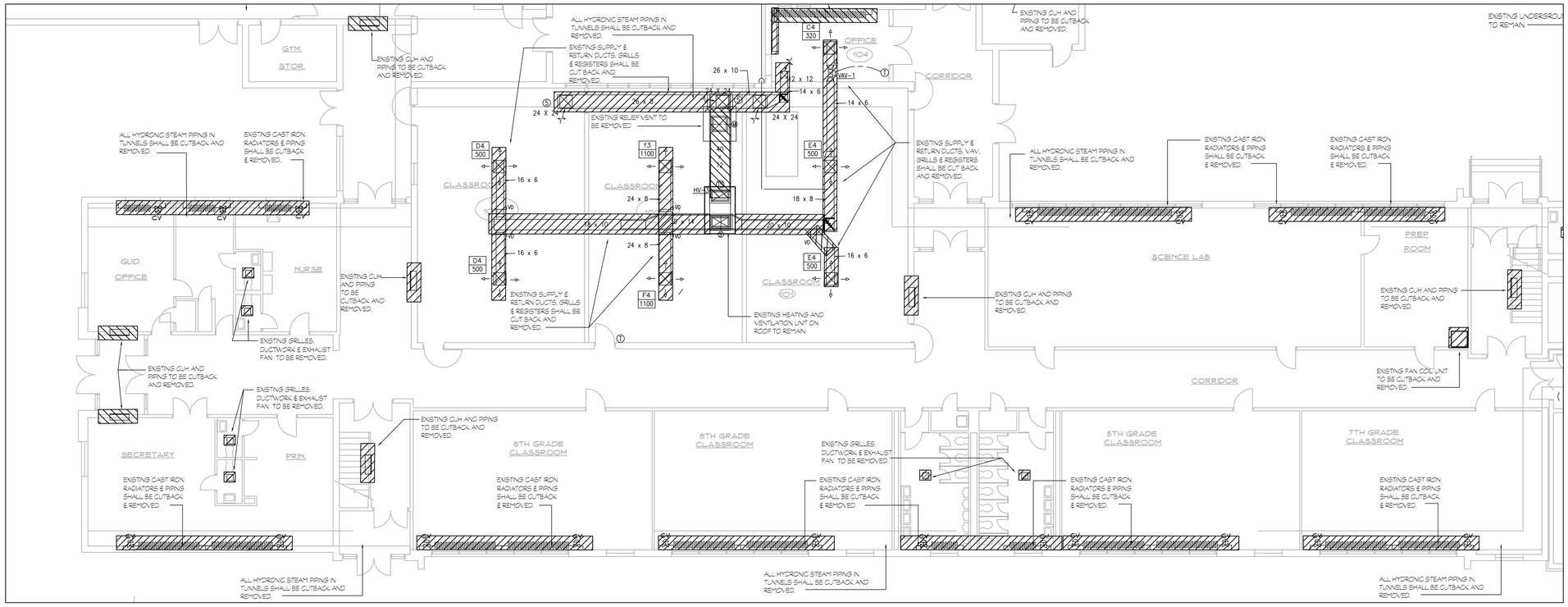
Revision:	Description:	Date:	Revised By:
1	ADDENDUM #1	11/1/2016	ARC

Drawing Title: Plumbing Schedules
State Project Number: TMP-084 JLGB
Date: 8/8/2016
Scale: AS NOTED
Drawn By: ARC
Project Number: 14.278
Drawing Number: P901



1 MD101 MECHANICAL MAIN LEVEL DEMO PLAN AREA-A

SCALE: 1/8" = 1'-0"

NOTE:
REMOVE ALL ASSOCIATED PIPING, WIRING, ACCESSORIES AND CONTROLS SERVING EXISTING HEATING TERMINAL EQUIPMENT BEING REMOVED.

GENERAL DEMOLITION NOTES

1. PHASE DEMOLITION TO MAINTAIN SYSTEMS AND BUILDING SERVICES AS REQUIRED DURING CONSTRUCTION. COORDINATE PHASING WITH CONSTRUCTION MANAGER.
2. PATCH, REPAIR AND SEAL ALL WALL AND ROOF OPENINGS RESULTING FROM MECHAINCAL/ELECTRICAL DEMOLITION. RESTORE FINISHES WITH MATERIALS MATCHING EXISTING. PROVIDE PROTECTION FROM WEATHER DURING CONSTRUCTION.
3. REWORK PIPING, DUCT AND ELECTRICAL CONNECTIONS FOR EQUIPMENT BEING RELOCATED.
4. ENSURE THAT POWER IS SECURED OFF PRIOR TO COMMENCING EQUIPMENT REMOVAL. SECURE POWER BACK TO PANEL FOR EQUIPMENT BEING REMOVED.
5. PROVIDE TEMPORARY CAPS OR COVERS FOR ALL OPENED PIPE, DUCT AND CONDUIT TO PREVENT INTRODUCTION OF FOREIGN MATERIAL.
6. ALL WASTE MATERIALS AND EQUIPMENT SHALL BE REMOVED FROM SITE AND LEGALLY DISPOSED OF BY THE CONTRACTOR.
7. STORE OR OTHERWISE PROTECT EQUIPMENT BEING RELOCATED FROM DAMAGE DURING CONSTRUCTION.

MECHANICAL DEMOLITION NOTES

1. ALL MECHANICAL SYSTEMS DESIGNATED FOR REMOVAL SHALL BE REMOVE IN THEIR ENTIRETY. REMOVE ALL EXISTING EQUIPMENT, PIPING, DUCTWORK AND CONTROLS INCLUDING ALL SUPPORTS, HANGERS, PADS AND FOUNDATIONS.
2. SYSTEM DEMOLITION SHALL BE PHASED IN CONJUNCTION WITH CONSTRUCTION PHASING AS REQUIRED TO MAINTAIN OCCUPANCY DURING CONSTRUCTION.
3. SYSTEMS DEPICTED ARE BASED ON AS-BUILT DRAWINGS AND SITE INVESTIGATION. DEMOLITION CONTRACTOR SHALL BE RESPONSIBLE FOR FIELD VERIFICATION OF SYSTEMS TO BE REMOVED.

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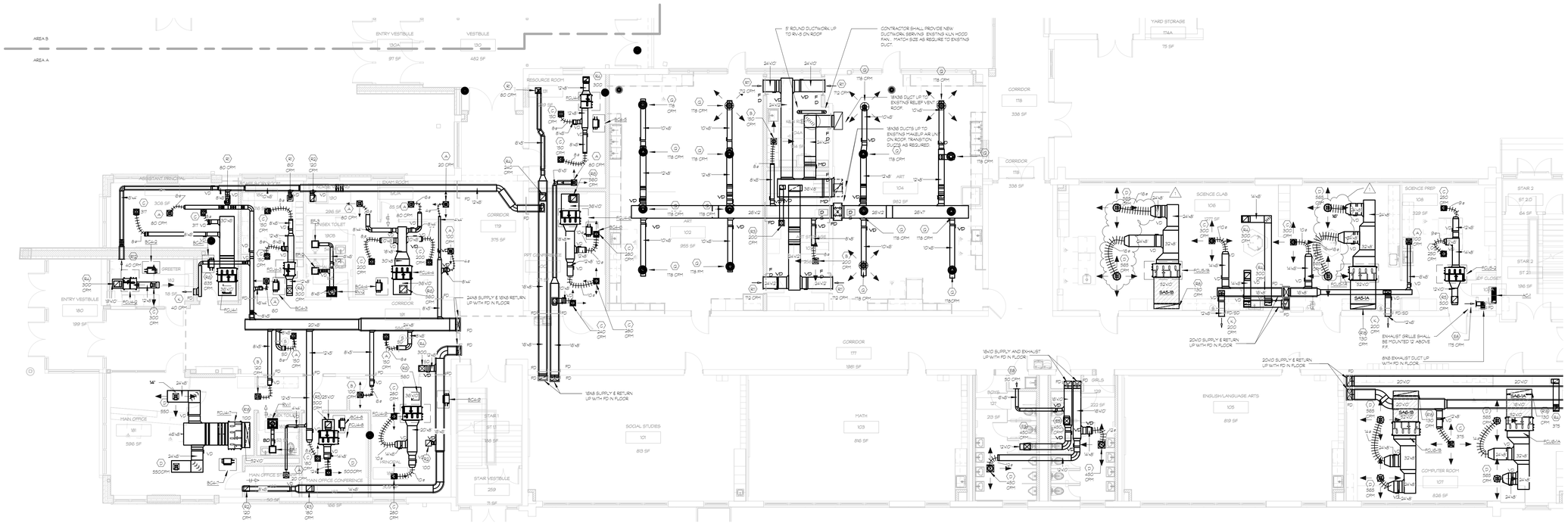
Revision:	Description:	Date:	Revised By:
1	ADDENDUM #1	11/11/2016	JP

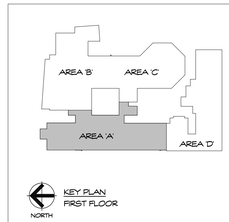
Revision:	Description:	Date:	Revised By:

Drawing Title:
MECHANICAL MAIN LEVEL DEMO PLAN AREA-A
State Project Number: TMP-084 JLGB

Date: 8/18/2016
Scale: AS NOTED
Drawn By: RL
Project Number: 14.278
Drawing Number: MD101



1 M101 MECHANICAL MAIN LEVEL DUCT PLAN AREA-A
SCALE: 1/8" = 1'-0"



KEY PLAN
FIRST FLOOR

Project Title:

Expansion and Alterations to:
WEST SHORE MIDDLE SCHOOL
70 Kay Avenue, Milford CT 06460

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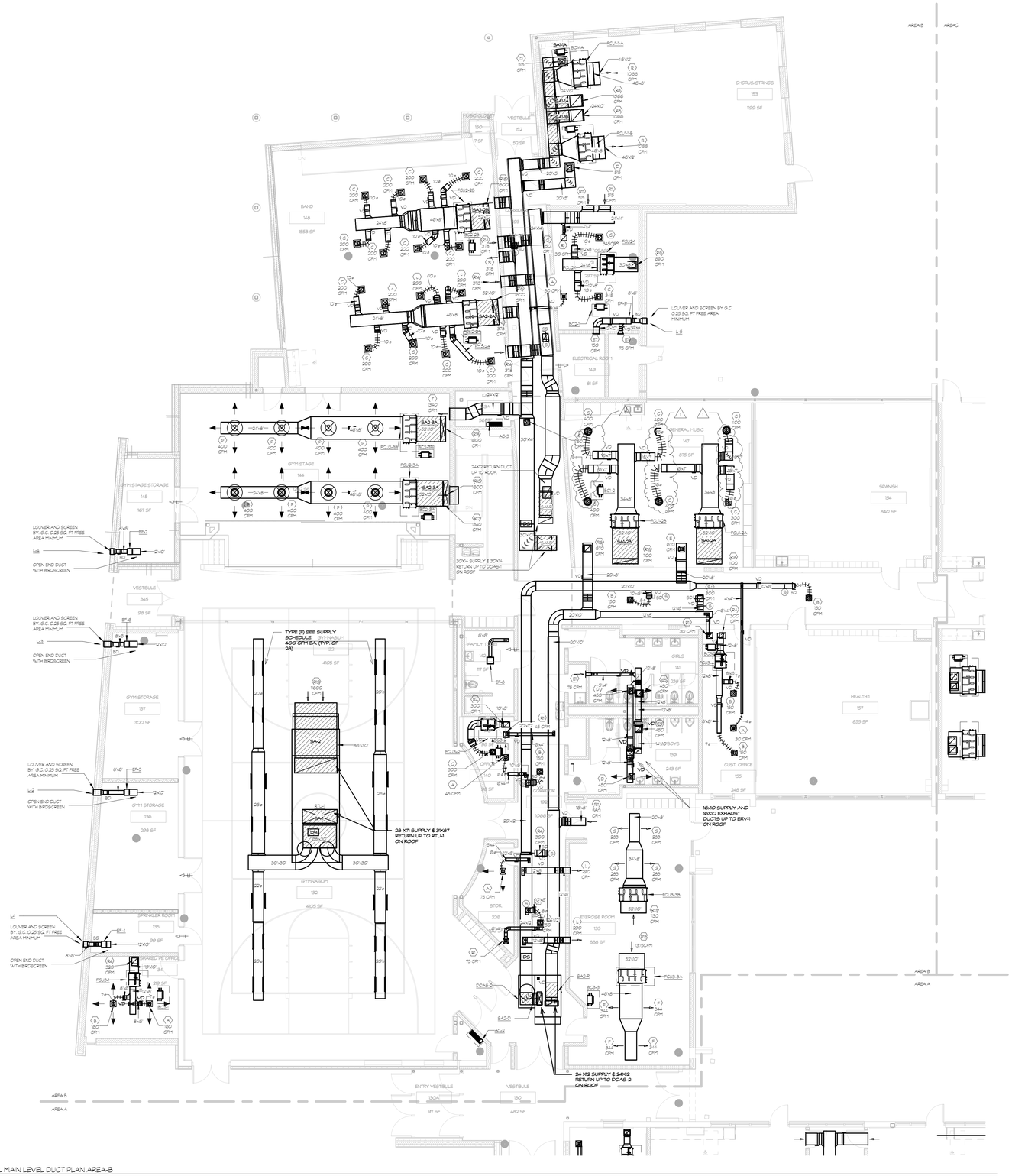
Revision:	*Description:*	*Date:*	*Revised By:*

Drawing Title:
MECHANICAL MAIN LEVEL
DUCT PLAN AREA-A

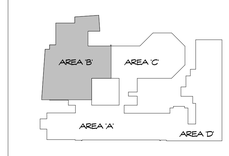
State Project Number: TMP-084-JLGB

Date: 8/18/2016
Scale: 1/8" = 1'-0"
Drawn By: RL
Project Number: 14.278

Drawing Number:
M101



1 M102 MECHANICAL MAIN LEVEL DUCT PLAN AREA-B
SCALE: 1/8 = 1'-0



NORTH
KEY PLAN
FIRST FLOOR

Project Title:

Expansion and Alterations to:
WEST SHORE MIDDLE SCHOOL
70 Kay Avenue, Milford CT 06460

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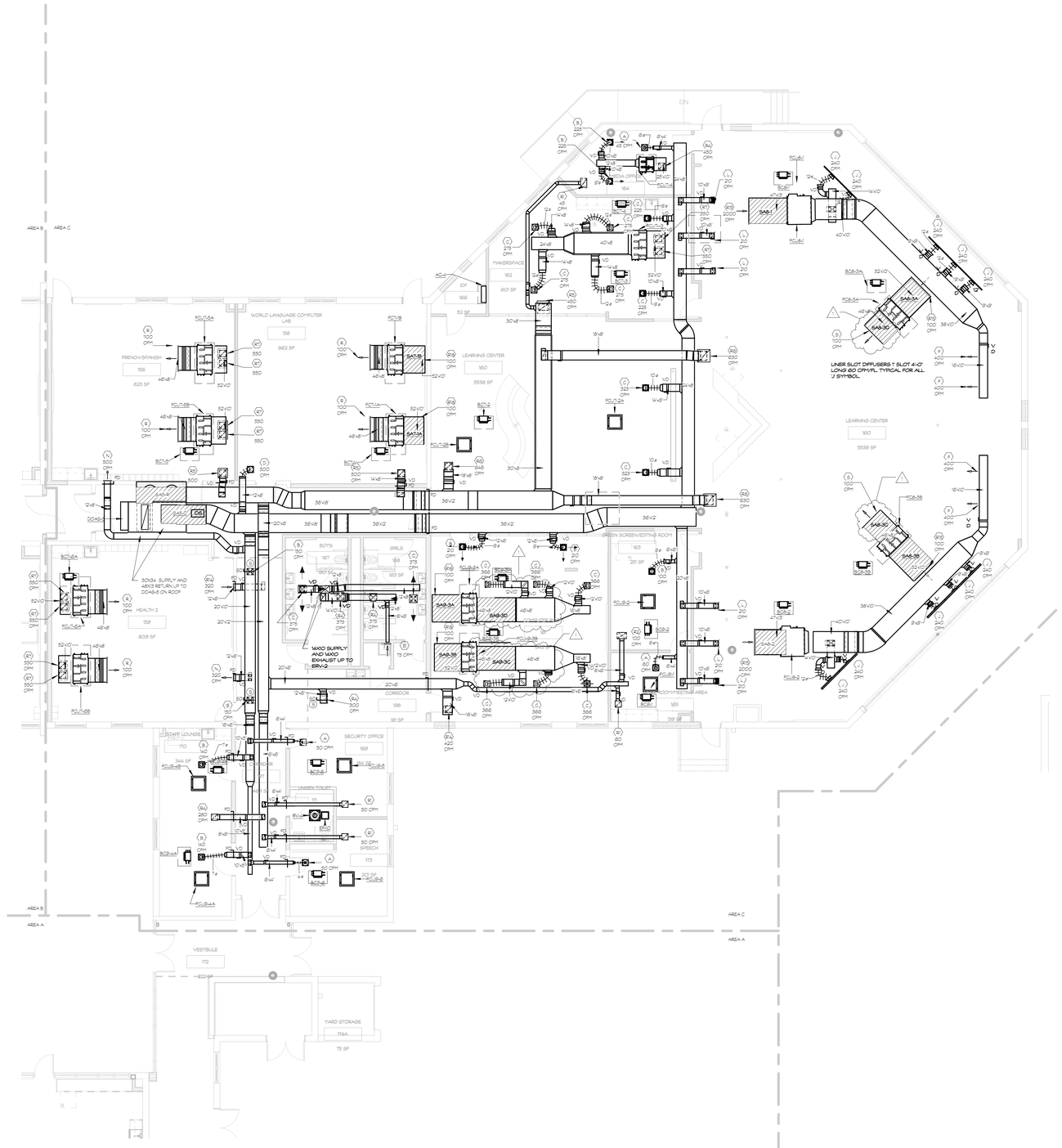
Drawing Title:
MECHANICAL MAIN LEVEL DUCT PLAN AREA-B

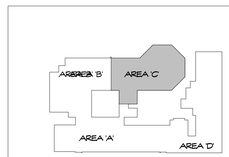
State Project Number: TMP-084-JLGB

Date: 8/18/2016
Scale: 1/8 = 1'-0
Drawn By: RL
Project Number: 14-218

Drawing Number: M102



1 M103 MECHANICAL MAIN LEVEL DUCT PLAN AREA-C
SCALE: 1/8" = 1'-0"



NORTH
KEY PLAN
FIRST FLOOR

Project Title:

Expansion and Alterations to:
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Revision:	Description:	Date:	Revised By:
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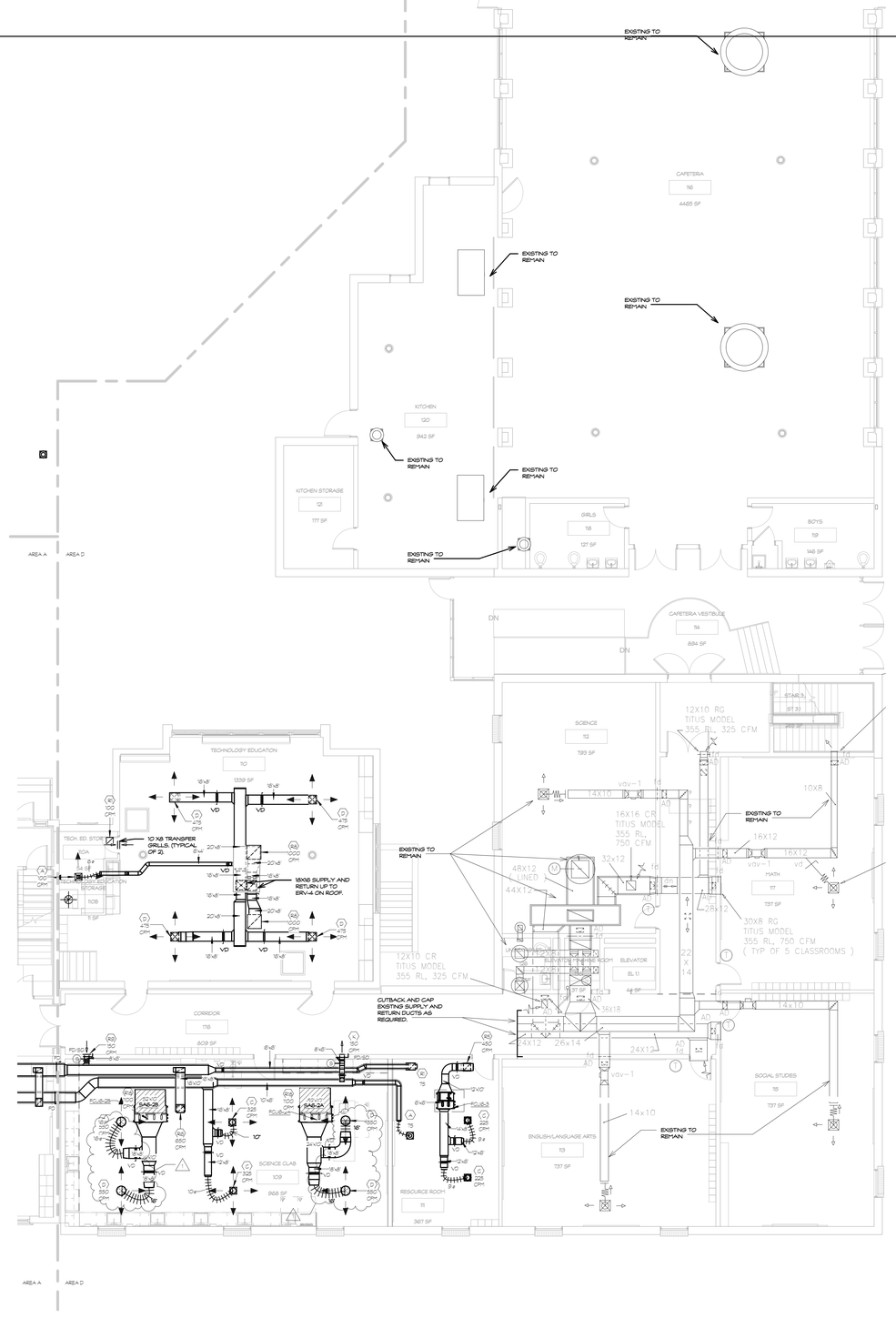
Revision:	Description:	Date:	Revised By:

Drawing Title:
MECHANICAL MAIN LEVEL DUCT PLAN AREA-C

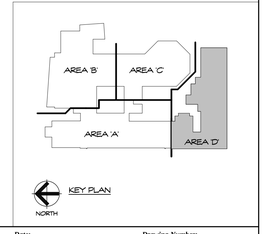
State Project Number: TMP-084-JLGB

Date: 8-18-2016
Scale: 1/8" = 1'-0"
Drawn By: RL
Project Number: 14-218

Drawing Number: M103



1 M104 MECHANICAL MAIN LEVEL DUCT PLAN AREA-D
SCALE: 1/8 = 1'-0



Project Title:

Expansion and Alterations to:

WEST SHORE MIDDLE SCHOOL

70 Kay Avenue, Milford CT 06460

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Revision:	Description:	Date:	Revised By:
1	ADDENDUM #1	7/1/2016	JP

Revision:	Description:	Date:	Revised By:

Drawing Title:

MECHANICAL MAIN LEVEL DUCT PLAN AREA-D

State Project Number: TMP-084-JLGB

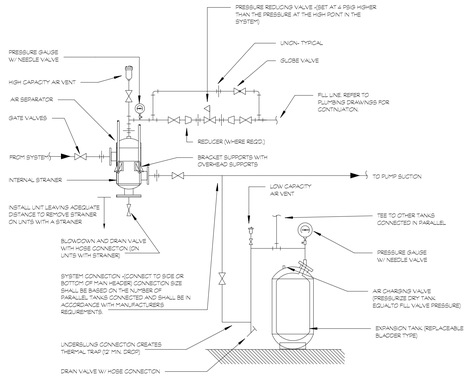
Date: 8/18/2016

Scale: 1/8 = 1'-0

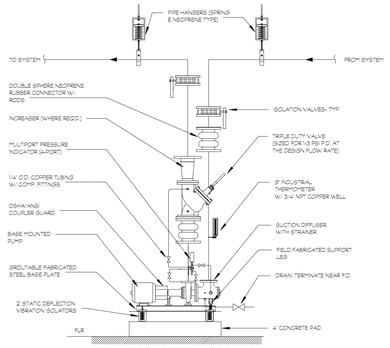
Drawn By: RL

Project Number: 14-218

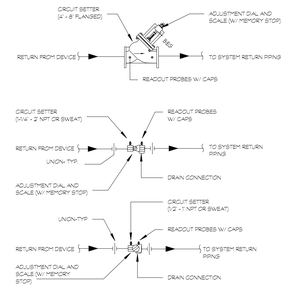
Drawing Number: M104



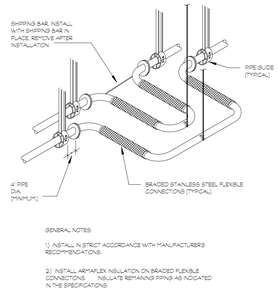
1 / M302 AIR SEPARATOR & EXPANSION TANK DETAIL
SCALE: 1/8" = 1'-0"



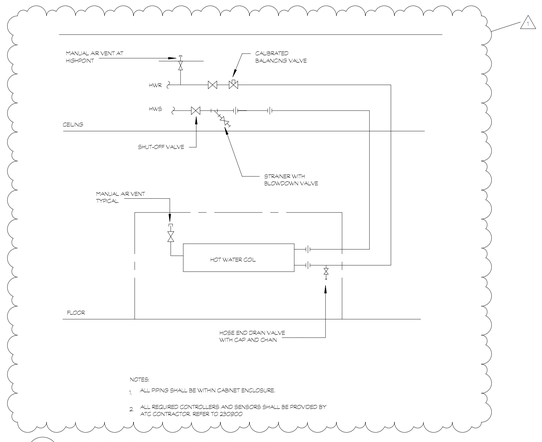
2 / M302 BASE MOUNTED PUMP DETAIL
SCALE: 1/8" = 1'-0"



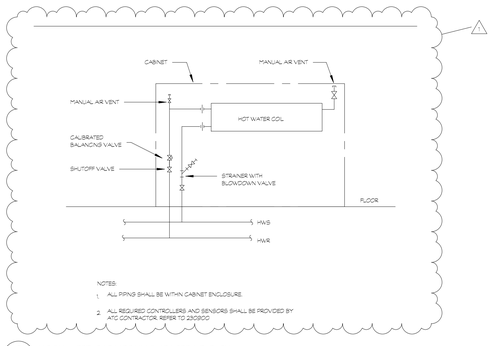
3 / M302 CALIBRATED BALANCING DEVICE DETAIL
SCALE: 1/8" = 1'-0"



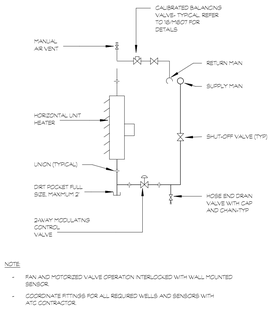
4 / M302 EXPANSION LOOP DETAIL
SCALE: 1/8" = 1'-0"



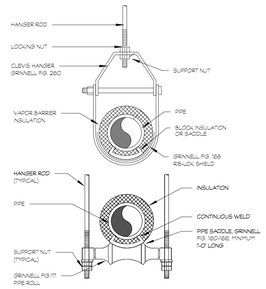
5 / M302 HOT WATER CABINET UNIT HEATER DOWNFLOW
SCALE: 1/8" = 1'-0"



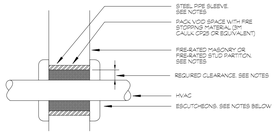
6 / M302 HOT WATER CABINET UNIT HEATER UP-FLOW
SCALE: 1/8" = 1'-0"



7 / M302 HOT WATER UNIT HEATER
SCALE: 1/8" = 1'-0"



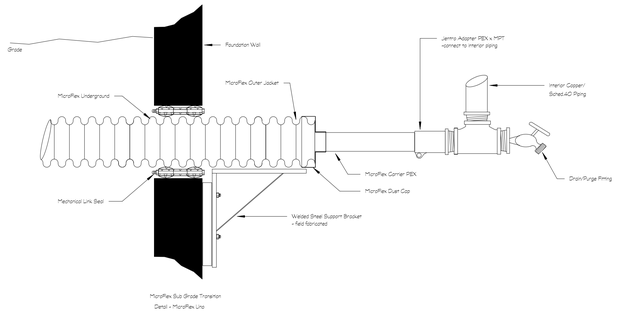
8 / M302 PIPING HANGING DETAIL
SCALE: 1/8" = 1'-0"



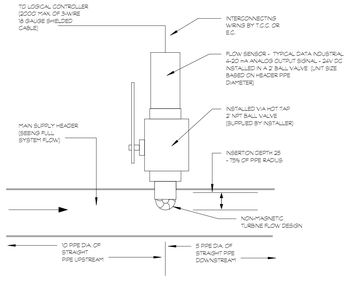
NOTES:
1. PIPE SLEEVES:
A. PIPE SLEEVES THROUGH FIRE-RATED MASONRY PARTITIONS OR FOUNDATION WALLS SHALL BE SCHEDULE 80 BLACK STEEL WITH PLAIN ENDS. PIPE SLEEVES SHALL BE FIELD-CUT TO LENGTH. SLEEVE SHALL BE EQUAL IN LENGTH TO DEPTH OF PARTITION OR FLOOR.
B. PIPE SLEEVES THROUGH FIRE-RATED STUD PARTITIONS SHALL BE FIB SHORE GALVANIZED STEEL WITH MAXIMUM OF 1" CLEARANCE BETWEEN SLEEVE AND PIPE. SLEEVE SHALL BE EQUAL IN LENGTH TO DEPTH OF PARTITION.

2. ESCUTCHEONS:
A. ESCUTCHEONS IN FINISHED SPACES SHALL BE ANODIZED ALUMINUM OR CHROME-PLATED BRASS.
B. ESCUTCHEONS IN UNFINISHED SPACES SHALL BE PLAIN BRASS, ALUMINUM, GALVANIZED STEEL OR CAST IRON.
C. ESCUTCHEONS SHALL BE HELD IN PLACE BY INTERNAL SPRING TENSION OR SET SCREW.

9 / M302 PIPING PENETRATION DETAIL
SCALE: 1/8" = 1'-0"



10 / M302 REINSULATED PEX PIPING CONNECTION
SCALE: 1/8" = 1'-0"



11 / M302 VARIBLE/CONSTANT SPEED FLOW SENSOR DETAIL
SCALE: 1/8" = 1'-0"

Project Title:

Expansion and Alterations to:

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Revision:	Description:	Date:	Revised By:
1	ADDENDUM #1	11/1/2018	JP

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Drawing Title:

MECHANICAL DETAILS

State Project Number: TMP-084-JLGB

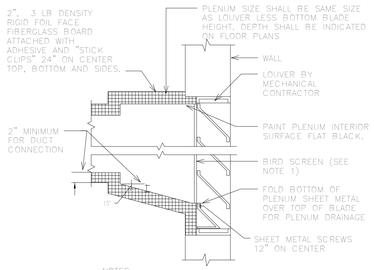
Date: 8/13/2018

Scale: 1/8" = 1'-0"

Drawn By: RL

Project Number: 14.218

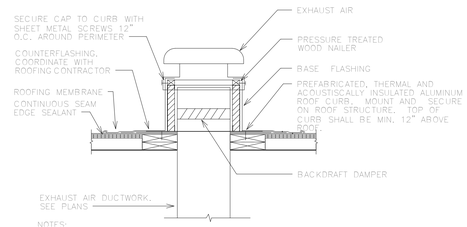
Drawing Number: M302



NOTES:

1. COVER INSIDE FACE OF LOUVER WITH 1/2" MESH ALUMINUM BIRD SCREEN SCREWED IN PLACE, IF NOT SUPPLIED WITH LOUVER.
2. INSULATE UNUSED PORTION OF LOUVER WITH 1 1/2" GLASS FIBER INSULATING BOARD.
3. SEAL ALL PLENUM SEAMS WATERTIGHT WITH SILICONE SEALANT.
4. TYPICAL FOR SUPPLY AND EXHAUST PLENUMS.
5. PROVIDE ACCESS DOOR IN PLENUM. DOOR SHALL BE FIELD COORDINATED FOR ACCESS. DOOR SIZE SHALL BE 36" HIGH x 18" WIDE. REFER TO SPEC FOR DOOR CONSTRUCTION.

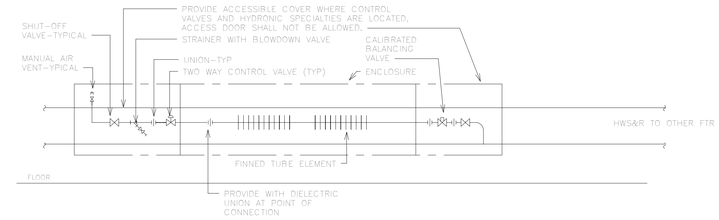
1 / M303 INTAKE AND EXHAUST LOUVER DETAIL
SCALE: 1/8"=1'-0"



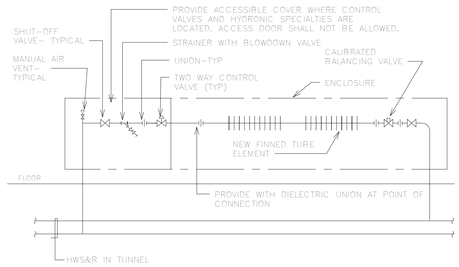
NOTES:

1. DRAWING AS SHOWN ARE FOR INFORMATION ONLY. CONTRACTOR SHALL PROVIDE ALL NECESSARY SUPPORT ACCESSORIES REQUIRED TO SECURE AND SEISMICALLY SUPPORT THE ROOF CURB TO THE STRUCTURE.
2. ALL INSTALLATION SHALL BE IN ACCORDANCE WITH THE MANUFACTURER'S REQUIREMENTS.
3. COORDINATE SEALING AND WATERPROOFING WITH THE ROOFING CONTRACTOR.
4. ROOF CURB, FLASHING AND ROOF CAP SHALL BE EPOXY COATED TO MATCH THE COLOR OF THE ROOF.

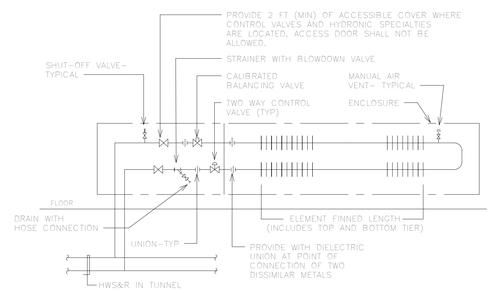
2 / M303 ROOF VENTILATOR DETAIL
SCALE: 1/8"=1'-0"



3 / M303 SINGLE TIER ELEMENT HOT WATER FINNED TUBE RADIATION
SCALE: 1/8"=1'-0"



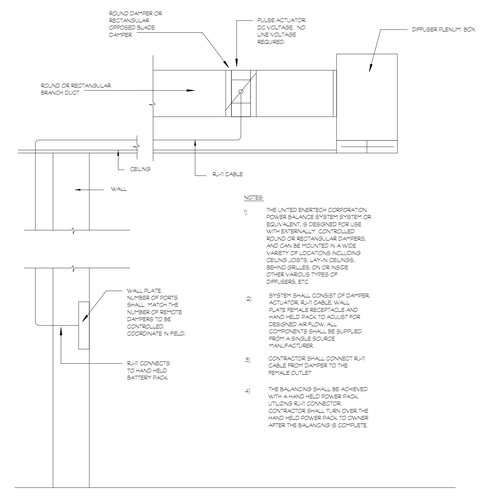
4 / M303 SINGLE TIER ELEMENT HOT WATER FINNED TUBE RADIATION UPFEED
SCALE: 1/8"=1'-0"



NEW FINNED TUBE RADIATION NOTES:

1. PROVIDE WALL TO WALL COVER
2. HYDRONIC CONTROLS AND SPECIALTIES SHALL BE INSTALLED WITHIN THE COVER.

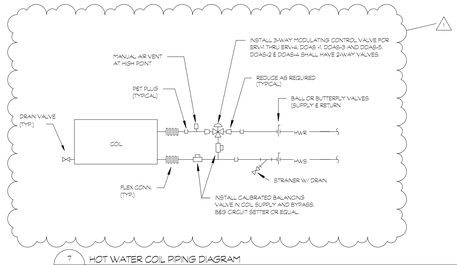
5 / M303 TWO TIER ELEMENT HOT WATER FINNED TUBE RADIATION UPFEED
SCALE: 1/8"=1'-0"



NOTES:

1. THE UNITED ENERTECH CORPORATION POWER BALANCE SYSTEM SYSTEM OR EQUIVALENT, IS DESIGNED FOR USE WITH EXTERNALLY CONTROLLED ROUND OR RECTANGULAR DAMPERS, AND CAN BE MOUNTED IN A WIDE VARIETY OF LOCATIONS INCLUDING CEILING JOISTS, LAY-IN CEILINGS, BEHIND GRILLES ON OR INSIDE OTHER VARIOUS TYPES OF DIFFUSERS, ETC.
2. SYSTEM SHALL CONSIST OF DAMPER, ACTUATOR, RJ-11 CABLE WALL PLATE FEMALE RECEPTACLE AND HAND HELD PACK TO ADJUST FOR DESIGNED AIR FLOW. ALL COMPONENTS SHALL BE SUPPLIED FROM A SINGLE SOURCE MANUFACTURER.
3. CONTRACTOR SHALL CONNECT RJ-11 CABLE FROM DAMPER TO THE FEMALE OUTLET.
4. THE BALANCING SHALL BE ACHIEVED WITH A HAND HELD POWER PACK. UTILIZING RJ-11 CONNECTOR. CONTRACTOR SHALL TURN OVER THE HAND HELD POWER PACK TO OWNER AFTER THE BALANCING IS COMPLETE.

6 / M303 REMOTE ACTUATED BALANCING DAMPER
SCALE: 1/8"=1'-0"



7 / M303 HOT WATER COIL PIPING DIAGRAM
SCALE: 1/8"=1'-0"

Project Title:

Expansion and Alterations to:

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Revision:	Description:	Date:	Revised By:
1	ADDENDUM #1	11/1/2018	JP

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Drawing Title:

MECHANICAL DETAILS

State Project Number: TMP-084-JLGB

Date: 8/13/2018

Scale: 1/8" = 1'-0"

Drawn By: RL

Project Number: 14.218

Drawing Number:

M303

PACKAGED ROOFTOP AIR CONDITIONING UNIT SCHEDULE

NUMBER	AREA SERVED	MANUFACTURER AND MODEL	UNIT														ENERGY RECOVERY											COOLING SECTION									HOT GAS REHEAT				GAS HEATING SECTION						OPER WEIGHT (LBS)	NOTES
			ELECTRICAL			EFFICIENCY	SUPPLY FAN			RETURN/EXHAUST FAN			FILTERS		CFM O.A.	RECOVERED CAPACITY		AIR CONDITIONS (°F)				APD (IN.WG.)	EFFECTIVENESS				EAT		LAT		TOATAL CAPACITY	SENSIBLE CAPACITY	AMBIENT	COMPRESSOR				TOATAL CAPACITY (BTU/HR)	EAT (°F)	LAT (°F)	APD (IN WG)	TYPE	TOATAL CAPacity (BTU/HR)	INPUT (BTU/HR)	STAGES	EDB (°F)	LDB (°F)		
			VOLTAGE	MCA (A)	MOCP (A)	EER/IEER	AIR FLOW (CFM)	ESP	TSP	MOTOR (HP)	AIR FLOW (CFM)	ESP	TSP	MOTOR (HP)	FACE AREA (FT^2)	EFFICIENCY		COOLING (BTU/HR)	HEATING (BTU/HR)	SUMMER EAT	SUMMER LAT	WINTER EAT	WINTER LAT		TOTAL COOLING	SENSIBLE COOLING	TOTAL HEATING	SENSIBLE HEATING	EDB (°F)	EWB (°F)	LDB (°F)	LWB (°F)			DB (°F)	QTY	STAGES	COMPRESSOR (KW)	REFRIGERANT		DB	DB	(IN WG)								
RTU-1	GYM	DAIKIN MPS040F	208/3/60	120	125	10.1/13.5	1200	2	5.16	20	1200	1.0	2.0	15	36	2" MERV 10	5600	198053	348317	95	79.1	7	59.8	0.79	0.76	0.78	0.77	0.78	77	63.7	51.1	50.0	432392	319413	95	4	MODULATING		36.5	R410A	225200	51.0	68	0.08	N9	640000	800000	MODULATING	50	102.7	7500	

NOTES:

1. PROVIDE BACNET CONTROL PANEL FOR INTERFACE WITH BUILDING MANAGEMENT SYSTEM. REFER TO SPEC SECTION 230900. COORDINATE WITH BMS CONTRACTOR.
2. FURNISH UNITS WITH SINGLE POINT POWER CONNECTION AND NON-FUSED DISCONNECT SWITCH.
3. ALL FAN MOTOR DRIVE ASSEMBLIES SHALL BE MOUNTED ON 1.5 INCH STATIC DEFLECTION VIBRATION ISOLATORS. COMPRESSORS SHALL BE MOUNTED ON RUBBER IN SHEAR ISOLATORS.
4. PROVIDE WITH INDIRECT CONDENSATE DRAINS WITH AN AIR GAP.
5. INSTALL UNIT ON VIBRATION ISOLATION SEISMIC ROOF CURB.

DEDICATED OUTSIDE AIR DEHUMIDIFICATION UNIT SCHEDULE

NUMBER	AREA SERVED	MANUFACTURER AND MODEL	UNIT														ENERGY RECOVERY WHEEL												COOLING SECTION											HOT WATER HEATING COIL									NOTES
			ELECTRICAL			EFFICIENCY		SUPPLY FAN			RETURN/EXHAUST FAN				FILTERS		CFM	RECOVERED CAPACITY		OA AIR CONDITIONS (°F)				APD (IN.WG.)	EFFECTIVENESS				ENTERING COIL		LEAVING COIL		TOATAL CAPACITY	SENSIBLE CAPACITY	AMBIENT	COMPRESSOR				TOATAL CAPACITY (BTU/HR)	EDB (°F)	LDB (°F)	EWT (°F)	GPM	MIN ROWS	FPI	MAX APD (IN WG)	MAX WPD (FT HD)	OPER WEIGHT	
			VOLTAGE	MCA (A)	MOCP (A)	EER	IEER	AIR FLOW (CFM)	ESP	TSP	MOTOR (HP)	AIR FLOW (CFM)	ESP	TSP	MOTOR (HP)	FACE AREA (FT^2)	EFFICIENCY		COOLING (BTU/HR)	HEATING (BTU/HR)	SUMMER EAT	SUMMER LAT	WINTER EAT	WINTER LAT		TOTAL COOLING	SENSIBLE COOLING	TOTAL HEATING	SENSIBLE HEATING	DB (°F)	WB (°F)	DB (°F)	WB (°F)			DB (°F)	QTY	COMPRESSOR (KW)	REFRIGERANT										
DOAS-1	'B' WING	DAIKIN DPS010A	208/60/3	54	70	12.4	19.3	3634	1.5	3.2	4	3634	1.5	3.2	4	18	2" MERV 10	3634	104771	164793	95.0	82.5	7.0	44.4	0.84	0.60	0.62	0.60	0.61	79.5	65.7	55.7	55.3	1216565	968690	95	2	8.2	R410A	214159	0	73.4	140	21.5	8	8	0.27	7.6	2800	1,2,3,4,5,6,8,9
DOAS-2	'B' WING	DAIKIN DPS007A	208/60/3	46	50	12.4	20.1	2000	1.5	2.3	4	2000	1.5	2.3	4	18	2" MERV 10	2000	76567	127331	95.0	79.8	7.0	53.3	0.49	0.71	0.74	0.73	0.74	79.8	65.9	52.3	52.3	88252	64981	95	2	11.9/8.6	R410A	153725	0	65.1	140	15.4	2	8	0.10	4.1	2500	1,2,3,4,5,6,7,9
DOAS-3	'A' WING	DAIKIN DPS007A	208/60/3	46	50	12.4	20.1	2040	1.5	2.3	4	2040	1.5	2.3	4	18	2" MERV 10	2040	67458	128935	95.0	79.6	7.0	54.2	0.45	0.72	0.76	0.74	0.76	82.5	67.7	53.2	53.2	89661	64079	95	2	11.9/8.6	R410A	146556	0	67.0	140	14.7	2	8	0.08	3.7	2500	1,2,3,4,5,6,7,9
DOAS-4	'A' WING	DAIKIN DPS007A	208/60/3	46	50	12.4	20.1	2350	1.5	2.3	2.3	2350	1.5	2.3	2.3	18	2" MERV 10	2350	72692	129140	95.0	79.9	7.0	53.1	0.50	0.71	0.74	0.73	0.74	79.2	65.7	52.1	52.1	87924	65185	95	2	11.9/8.6	R410A	155472	0	64.6	140	15.5	2	8	0.10	4.1	2500	1,2,3,4,5,6,7,9
DOAS-5	'C' WING	DAIKIN DPS016A	208/60/3	94	125	12.2	21.0	4800	1.5	3.1	4	4800	1.5	2.3	4	27	2" MERV 10	4800	156747	277141	95.0	81.2	7.0	48.7	0.66	0.65	0.68	0.67	0.68	82.1	67.4	55.8	55.7	189363	148630	95	1	47.0	R410A	430637	0	76.3	140	43.5	2	12	0.24	1.2	4800	1,2,3,4,5,6,7,9

NOTES:

1. PROVIDE BACNET CONTROL PANEL FOR INTERFACE WITH BUILDING MANAGEMENT SYSTEM. REFER TO SPEC SECTION 230900. COORDINATE WITH BMS CONTRACTOR.
2. FURNISH UNITS WITH SINGLE POINT POWER CONNECTION AND NON-FUSED DISCONNECT SWITCH.
3. PROVIDE INTERNAL PIPE CHASE. UNIT CASING SHALL ACCOMMODATE HOT WATER COIL PIPING AND ACCESSORIES INCLUDING CONTROL VALVES AND SHUTOFF VALVES.
4. ALL FAN MOTOR DRIVE ASSEMBLIES SHALL BE MOUNTED ON 1.5 INCH STATIC DEFLECTION VIBRATION ISOLATORS. COMPRESSORS SHALL BE MOUNTED ON RUBBER IN SHEAR ISOLATORS.
5. PROVIDE WITH CONDENSATE DRAINS WITH TRAP PER MANUFACTURERS RECOMMENDATIONS.
6. EXTERNAL STATIC PRESSURE INCLUDES 1.0 IN WG ALLOWANCE FOR DIRTY FILTERS.
7. FURNISH WITH MANUFACTURERS SEISMIC ROOF CURB.
8. INSTALL UNIT ON SEISMIC VIBRATION ISOLATION CURB AND VIBRATION ISOLATION CONDENSER SECTION CURB SUPPORT.
9. FOR HOT WATER COIL PIPING, REFER TO HOT WATER COIL PIPING DIAGRAM, DRAWING H503.

ENERGY RECOVERY VENTILATOR SCHEDULE

NUMBER	MANUFACTURER AND MODEL	SUPPLY AIR FAN				EXHAUST AIR FAN				ELECTRICAL			HOT WATER COIL							FILTERS		ENERGY RECOVERY CORE										
		NOMINAL CFM	SP (IN WG)		HP	NOMINAL CFM	SP (IN WG)		HP	Volts/Phs/Hz	MCA	MOCP	MINIMUM HEATING CAPACITY (~BH)	EAT (°F)	MIN LAT (°F)	EWT (°F)	LWT (°F)	GPM	MAX WPD (FT.HD.)	MAX APD (IN.WG.)	MIN ROWS	OUTSIDE AIR	EXHAUST AIR	TYPE	EXH CFM	OA CFM (MAX)	MAX APD (IN.WG.)	SUMMER OA		SUMMER EXH		WINTER OA		WINTER EXH		OPER WT (LBS)
			TSP	ESP			TSP	ESP																				EAT °F DB/WB	LAT °F DB/WB	EAT °F DB/WB	LAT °F DB/WB	EAT °F DB	LAT °F DB	EAT °F DB/RH	LAT °F DB	
ERV-1	AMERICAN ALDES SE2000E	875	1.56	1	0.75	875	1.45	1	0.75	208/3/60	9	10	41	46	67	140	120	4.2	1.02	0.11	2	MERV 8	MERV 8	ENTHALPY CORE	875	875	1.0	67/73	80/69	75/63	82/68	11	46	72/28	35	1,400
ERV-2	AMERICAN ALDES SE2000E	750	1.56	1	0.75	825	1.45	1	0.75	208/3/60	9	10	41	46	67	140	120	4.2	1.02	0.11	2	MERV 8	MERV 8	ENTHALPY CORE	825	825	1.0	67/73	80/69	75/63	82/68	11	46	72/28	35	1,400
ERV-3	AMERICAN ALDES SE3000E	1,700	2.0	1	3	1900	1.8	1	3	208/3/60	22	30	123	43	95	140	120	12.6	2	0.26	2	MERV 8	MERV 8	ENTHALPY CORE	1900	1900	.38	67/73	80/69	75/63	81/67	11	43	72/28	39	1,800
ERV-4	AMERICAN ALDES SE3000E	1,800	2.0	1	3	2050	1.8	1	3	208/3/60	22	30	123	43	95	140	120	12.6	2	0.26	2	MERV 8	MERV 8	ENTHALPY CORE	2050	2000	.38	67/73	80/69	75/63	81/67	11	43	72/28	39	1,800

1. UNIT CONTROLS SHALL BE FURNISHED BY BMS MANUFACTURER.
2. FURNISH UNITS WITH SINGLE POINT POWER CONNECTION AND NON-FUSED DISCONNECT.
3. FURNISH UNITS WITH 100% INTAKE, EXHAUST AND RECIRCULATION AIR DAMPERS.
4. PROVIDE DIRECT DRIVE EC MOTORS FOR SUPPLY AND EXHAUST FANS.
5. EXHAUST DEFROST CYCLES FACTORY- CALIBRATED SET POINT, INCLUDES MOTORIZED AND INSULATED DAMPER ON FRESH AIR INTAKE AND EXHAUST.
6. FURNISH WITH MANUFACTURER'S ROOF CURB.

FAN SCHEDULE

SYMBOL	AREA SERVED	MANUFACTURER	MODEL	TYPE	CFM	STATIC PRESS (IN. WG)	FAN RPM	ELECTRICAL			WEIGHT (LBS)	SONES	CONTROL INTERLOCK	REMARKS
								VOLTS	PH	HP (WATTS)				
EF-1	FEMALE TOILET AREA-A	LOREN COOK	GC-148	CEILING	100	.5	1056	120	1	(80)	15	3.2	LIGHT TIMER SWITCH	1,2,4,6,7
EF-2	FEMALE TOILET AREA-A	LOREN COOK	GC148	CEILING	100	.5	1056	120	1	(80)	15	3.2	LIGHT TIMER SWITCH	1,2,4,6,7
EF-3	UNISEX TOILET AREA-A	LOREN COOK	GC-148	CEILING	100	.5	1056	120	1	(80)	15	3.2	LIGHT TIMER SWITCH	1,2,4,6,7
EF-4	SPRINKLER RM AREA-B	LOREN COOK	GN-148	IN-LINE	110	.25	988	120	1	(82)	15	1.6	SPACE THERMOSTAT	1,2,3,4,6,7
EF-5	GYM STORAGE AREA-B	LOREN COOK	GN-158	IN-LINE	150	.25	1137	120	1	(112)	15	2.4	SPACE THERMOSTAT	1,2,3,4,6,7
EF-6	GYM STORAGE AREA-B	LOREN COOK	GN-186	IN-LINE	175	.25	765	120	1	(131)	15	3.1	SPACE THERMOSTAT	1,2,3,4,6,7
EF-7	GYM STORAGE AREA-B	LOREN COOK	GN-148	IN-LINE	150	.25	1137	120	1	(112)	15	2.4	SPACE THERMOSTAT	1,2,3,4,6,7
EF-8	FAMILY TOILET AREA-B	LOREN COOK	GC-148	CEILING	100	.5	1056	120	1	(80)	15	3.2	LIGHT TIMER SWITCH	1,2,4,6,7
EF-9	ELECT. RM AREA-B	LOREN COOK	GN-422	IN-LINE	225	.25	988	120	1	(138)	30	2.4	SPACE THERMOSTAT	1,2,3,4,6,7
EF-10	FEMALE TOILET AREA-C	LOREN COOK	GC-148	CEILING	100	.5	1056	120	1	(80)	15	3.2	LIGHT TIMER SWITCH	1,2,4,6,7
EF-11	KILN RM AREA-A	EXISTING	----	IN-LINE	265	----	----	120	1	----	----	----	WALL SWITCH	----
EF-12	SCIENCE PREP AREA-A	LOREN COOK	190CSD M	ROOF	175	.5	----	120	1	.125	30	5.0	8:15 - TO RUN CONTINUOUS 24/7	1,2,4,6,7

REMARKS:

1. FURNISH WITH FACTORY WIRED SPEED CONTROLLER, DISCONNECT AND BACKDRAFT DAMPER.
2. PROVIDE FLEXIBLE CONNECTORS ON DUCTWORK CONNECTIONS TO FANS.
3. FOR IN-LINE FANS, PROVIDE RUBBER-IN-SHEAR VIBRATION ISOLATORS.
4. FAN CONTROL INTERLOCKS INDICATED ABOVE SHALL BE WIRED UNDER DIVISION 26.
5. UNLESS NOTED OTHERWISE, MOUNT SPEED CONTROL SWITCH NEXT TO UNIT FOR BALANCING PURPOSES.
6. TRANSITION DUCTWORK ON INLET AND OUTLET OF EACH FAN TO MATCH SIZES SHOWN ON PLANS.
7. CAPACITIES LISTED ARE AS BALANCED WITH FAN SPEED CONTROLLER, NOT THE MAXIMUM CAPACITY.

ROOF INTAKE/RELIEF VENTILATOR SCHEDULE

SYMBOL	INTAKE OR RELIEF	CFM	MODEL	CURB DATA			WEIGHT	HEIGHT (IN)	CURB DATA		REMARKS
				LENGTH	THROAT DATA WIDTH	SQ.FT			ROOF OPENING	OUTSIDE DIMENSIONS	
RV-1	RELIEF	100	6PR	8-5/8"	DIA	18	14	8:125	13.5X13.5	18X18	1,2,3,4
RV-2	RELIEF	200	6PR	8-5/8"	DIA	18	14	8:125	13.5X13.5	18X18	1,2,3,4
RV-3	RELIEF	100	6PR	8-5/8"	DIA	18	14	8:125	13.5X13.5	18X18	1,2,3,4
RV-4	RELIEF	100	6PR	8-5/8"	DIA	18	14	8:125	13.5X13.5	18X18	1,2,3,4
RV-5	RELIEF	265	12PR	12+/-2	DIA	20	14	10:125	15.5X15.5	27X27	1,2,3,4

NOTES:

1. MODEL NUMBERS LISTED ABOVE ARE BASE ON LOREN COOK COMPANY.
2. ROOF CURBS SHALL BE INSULATED LEVEL TOP TYPE 'B' MINIMUM HEIGHT AS SUPPLIED BY VENTILATOR MANUFACTURER.
3. VENTILATOR TO HAVE TIGHT CLOSING BACKDRAFT DAMPER AND INSECT SCREEN.
4. COLOR SUBJECT TO ARCHITECT'S APPROVAL.

DUCTLESS SPLIT SYSTEM AIR CONDITIONING

SYMBOL	MANUFACTURER & MODEL	AREA SERVED	COOLING CAPACITY	HEATING CAPACITY	CFM	EAT (DB/WB)	AMBIENT AIR TEMP (°F)	ELECTRICAL			REFRIGERANT LINES		TYPE	HEIGHT	WIDTH	DEPTH	WEIGHT	REMARKS:
					L/H			VOLTS/Φ	PH	MCA	IQ (IN)	SUCM(IN)						
AC-1	DAIKIN FTKN09NMVJU	IDF ROOM AREA 'A'	9,000	----	145/403	80/67	95	208	1	--	1/4	3/8	R410A	11-1/4"	30-3/8"	8-3/4"	20	
CU-10	DAIKIN RKN09NMVJU	----	9,000	----	----	----	----	208	1	7.9	1/4	3/8	R410A	21-5/8"	26-9/16"	11-3/16"	60	
AC-2	DAIKIN FTKN09NMVJU	IDF ROOM AREA 'B'	9,000	----	145/403	80/67	95	208	1	--	1/4	3/8	R410A	11-1/4"	30-3/8"	8-3/4"	20	
CU-11	DAIKIN RKN09NMVJU	----	9,000	----	----	----	----	208	1	7.9	1/4	3/8	R410A	21-5/8"	26-9/16"	11-3/16"	60	
AC-3	DAIKIN FTKN09NMVJU	IDF ROOM AREA 'B'	9,000	----	145/403	80/67	95	208	1	--	1/4	3/8	R410A	11-1/4"	30-3/8"	8-3/4"	20	
CU-12	DAIKIN RKN09NMVJU	----	9,000	----	----	----	----	208	1	7.9	1/4	3/8	R410A	21-5/8"	26-9/16"	11-3/16"	60	
AC-4	DAIKIN FTKN09NMVJU	IDF ROOM AREA 'C'	9,000	----	145/403	80/67	95	208	1	--	1/4	3/8	R410A	11-1/4"	30-3/8"	8-3/4"	20	
CU-13	DAIKIN RKN09NMVJU	----	9,000	----	----	----	----	208	1	7.9	1/4	3/8	R410A	21-5/8"	26-9/16"	11-3/16"	60	

NOTES:

1. FURNISH UNITS WITH INTEGRAL CONDENSATE PUMPS.

LOUVER SCHEDULE

SYMBOL	MANUFACTURER MODEL NUMBER	SERVICE	CFM	INLET/OUT VELOCITY (FPM)	FREE AREA (SQ FT)	NOM. WIDTH (IN)	NOM. HEIGHT (IN)	PD IN. WG	REMARKS
L-1	RUSKIN ELF-375DX	EXHAUST	100	440	0.25	12	12	--	1,2,3,4,5
L2	RUSKIN ELF-375DX	EXHAUST	150	600	0.25	12	12	--	1,2,3,4,5
L-3	RUSKIN ELF-375DX	EXHAUST	175	700	0.25	12	12	--	1,2,3,4,5
L-4	RUSKIN ELF-375DX	EXHAUST	150	600	0.25	12	12	--	1,2,3,4,5
L-5	RUSKIN ELF-375DX	EXHAUST	225	600	0.375	12	12	--	1,2,3,4,5

REMARKS:

1. PROVIDE WITH BIRD SCREEN.
2. ALL LOUVERS SHALL BE POWER COATED FINISH. FINAL COLOR SUBJECT TO ARCHITECTS APPROVAL.
3. PROVIDE WITH FULL SIZE INSULATED PLENUMS.

Project Title:

Expansion and Alterations to:

WEST SHORE MIDDLE SCHOOL

70 Kay Avenue, Milford CT 06460

SILVER / PETRUCELLI + ASSOCIATES

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Revision:	Description:	Date:	Revised By:
1	ADDENDUM #1	11/1/2018	JP

Drawing Title:

MECHANICAL SCHEDULES

State Project Number: TMP-084-JLGB

Date: 8-18-2018

Scale: 1/8" = 1'-0"

Drawn By: RL

Project Number: 14.278

Drawing Number:

M400

PIPE SEISMIC/EXPANSION LOOP SCHEDULE

SYMBOL	MANUFACTURER & MODEL	TYPE	PIPE SIZE (INCHES)	LENGTH x HEIGHT (INCHES)	MOVEMENT (INCHES)	NOTES
SL-1	METRAFLEX V-LOOP	STANLESS STEEL BRAIDED	1	25 x 9	4	
SL-1.5	METRAFLEX V-LOOP	STANLESS STEEL BRAIDED	1-1/2	33 x 12	4	
SL-2	METRAFLEX V-LOOP	STANLESS STEEL BRAIDED	2	37 x 14	4	
SL-2.5	METRAFLEX V-LOOP	STANLESS STEEL BRAIDED	2	38 x 17	4	
SL-3	METRAFLEX V-LOOP	STANLESS STEEL BRAIDED	3	41 x 18	4	
SL-4	METRAFLEX V-LOOP	STANLESS STEEL BRAIDED	4	47 x 21	4	

NOTES:
1. PROVIDE FLANGED, GROOVED, WELDED OR THREADED ENDS AS REQUIRED.

EXPANSION TANK SCHEDULE

SYMBOL	MANUFACTURER MODEL NUMBER	TYPE	LOCATION	ACCEPTANCE VOLUME (GAL)	SIZE (DIA x H)	WEIGHT
ET-1	AMTROL 400-L	VERTICAL BLADDER	BOILER ROOM	106	24 x 68	1200

HVAC PUMP SCHEDULE

SYMBOL	TYPE	GPM	FT. HD.	MOTORS			SERVICE	FLUID	MANUFACTURER & MODEL	MOTOR CONTROL (VFD OR ECM)	NOTES
				RPM	HP	VOLTS/PHS					
BP-1	IN-LINE ECM	278	17	VARIABLE	2	208/1	BOILER CIRCULATOR	WATER	GRUNDFOS MAGNA 3 - 100-120 F	ECM	1
BP-2	IN-LINE ECM	278	17	VARIABLE	2	208/1	BOILER CIRCULATOR	WATER	GRUNDFOS MAGNA 3 - 100-120 F	ECM	1
P-1	PACKAGED MULTI - PUMP SYSTEM	334	95	VARIABLE	7.5	208/3	PRIMARY BUILDING LOOP	WATER	GRUNDFOS HYDRO MPC E 3CRE32-2-1	VFD	2, 3, 4, 5, 6
P-2				VARIABLE	7.5	208/3					
P-3				VARIABLE	7.5	208/3					

NOTES
1. FURNISH WITH SUCTION DIFFUSER AND PUMP MOUNTED MOTOR CONTROLLER.
2. PROVIDE MULTI - PUMP PACKAGE CONSISTING OF P-1, P-2 & P-3 FACTORY MOUNTED ON STRUCTURAL BASE WITH 6" INLET AND DISCHARGE MANIFOLDS AND ISOLATION VALVES FOR EACH PUMP.
3. PROVIDE PUMP MOUNTED VARIABLE FREQUENCY DRIVES AND MANUFACTURERS CONTROL PANEL WITH SINGLE POINT POWER CONNECTION.
4. FACTORY CONTROLLER SHALL INTERFACE WITH NEW BUILDING MANAGEMENT SYSTEM. COORDINATE SYSTEM REQUIREMENTS WITH BMS CONTRACTOR.
5. GPM AND FT HD ARE MINIMUM CAPACITY FOR TWO PUMP OPERATION WITH THIRD PUMP STANDBY.
6. MOUNT PUMP PACKAGE ON 4" REINFORCED CONCRETE PAD, ON 2 INCH STATIC DEFLECTION VIBRATION ISOLATORS.

SOUND ATTENUATOR SCHEDULE–RTU & DOAS UNITS

TAG	TYPE	DIMENSIONS (inches)			AIR FLOW (CFM)	VELOCITY (FPM)	MAX. PD in wg	MAX. PD WITH SYS. EFF. in. wg.	MINIMUM DYNAMIC INSERTION LOSS, dB / MAXIMUM SELF GENERATED NOISE, dB / OCTAVE BAND CENTER FREQUENCY, HZ								BASIS OF DESIGN VIBRO-ACOUSTICS MODEL NUMBER	NOTES
		WIDTH OR DIA	HEIGHT	LENGTH					63	125	250	500	1000	2000	4000	8000		
SA1-D	RED	30	14	72	3834	-1840	0.27	0.33	5	9	15	22	36	39	25	19	RED-LH-F9 - L9361	ELBOW
SA1-R	RED	30	14	72	3834	-1840	0.15	0.27	8	13	21	32	35	36	28	23	EXRED-HM-F5 - L9361	ELBOW
SA2-D	RD	24	12	48	2000	-1000	0.02	0.25	8	10	14	24	25	26	19	17	RD-LV-F9 - L9361	STRAIGHT
SA2-R	RED	24	12	72	2000	-1000	0.02	0.24	8	13	20	31	32	33	26	22	RED-HM-F4 - L9361	ELBOW
SA3-D	RED	28	10	70	2040	-1049	0.16	0.35	6	11	20	32	36	35	31	26	TRED-HV-F5 - L9361	ELBOW
SA3-R	RED	28	10	72	2040	-1049	0.25	0.27	7	13	23	32	37	39	30	25	RED-HM-F6 - L9361	ELBOW
SA4-D	RED	24	10	84	2350	-1692	0.25	0.28	6	11	19	27	36	36	31	26	RED-LH-F6 - L9361	ELBOW
SA4-R	RED	20	10	36	1175	-846	0.22	0.24	5	9	12	21	25	22	16	17	RED-HV-F6 - L9361	ELBOW
SA5-D	RED	36	18	96	4800	-1600	0.16	0.18	7	15	19	29	36	37	28	20	RED-LH-F4 - L9361	ELBOW
SA5-R	RD	30	12	36	4800	-1920	0.15	0.16	3	8	11	12	14	13	12	10	RD-HV-F1 - L9361	STRAIGHT
SA-1,	RED	30	66	60	1,000	-700	0.06	0.08	8 55	13 33	20 29	30 27	26 30	25 24	21 11	17 25	RED-HV-F1 - L9361	ELBOW
SA-2	RED	30	66	144	1,000	-700	0.06	0.1	13 56	31 36	46 33	49 37	55 21	50 13	37 10	32 12	RED-HV-F4 - L9361	ELBOW

FINNED TUBE RADIATION SCHEDULE

TAG	MANUFACTURER & MODEL	NUMBER OF TIERS PER ELEMENT	FLOW (GPM)	HEATING CAPACITY AT 130°F AVT & GPM INDICATED (BTUH/LF)	HEATING ELEMENT TUBE & FINS	FINS/FT	ELEMENT ACTIVE LENGTH (LINEAR FEET)	ENCLOSURE HEIGHT / MOUNTING HEIGHT (AFF)	ENCLOSURE TYPE	REMARKS
FTR-1	STERLING JVB-S	2	2.2	902	3/4" COPPER 4-1/4" x 3-5/8" ALUM	50	AS INDICATED ON DRAWINGS	20" / 4"	SLOPE TOP	1,2,3,4,5,6,7,8
FTR-2	STERLING JVB-S	2	4.4	910	1" COPPER 4-1/4" x 3-5/8" ALUM	50	AS INDICATED ON DRAWINGS	20" / 4"	SLOPE TOP	1,2,3,4,5,6,7,8
FTR-3	STERLING JVB-S	2	2.2	902	3/4" COPPER 4-1/4" x 3-5/8" ALUM	50	AS INDICATED ON DRAWINGS	20" / 4"	SLOPE TOP	1,2,3,4,5,6,7,8,9
FTR-4	STERLING JVB-SS	2	4.4	835	1" COPPER 4-1/4" x 3-5/8" ALUM	50	AS INDICATED ON DRAWINGS	24" / 8"-0"	SLOPE TOP & BOTTOM	1,2,3,4,5,6,7,8
FTR-5	STERLING JVB	2	2.2	902	3/4" COPPER 4-1/4" x 3-5/8" ALUM	50	AS INDICATED ON DRAWINGS	8"	NONE (BARE ELEMENT)	1,3,4,6,8,10

REMARKS:
1. REFER TO PLANS FOR QUANTITY AND LOCATION. PROVIDE ELEMENT FINNED LENGTH AS INDICATED ON PLANS.
2. SLOPE TOP ENCLOSURE. PROVIDE WITH FULL HEIGHT BACK PLATE, ELEMENT AND PIPING SUPPORT BRACKETS, END CAP, TRIM STRIPS
3. PROVIDE A MINIMUM OF 2 FEET COVER AT EACH END FOR CONTROL VALVES AND SPECIALTIES ACCESS.
4. PROVIDE SUPPORT FOR HWS AND HWR PIPE INSIDE ENCLOSURE
5. PROVIDE CONTINUOUS WALL TO WALL ENCLOSURE. COORDINATE WITH ARCHITECTURAL FINISHES, FURNITURE & EQUIPMENT.
6. CONTROL VALVE AND WALL SENSOR SHALL BE BY ATC CONTRACTOR. REFER TO SECTION 23 09 00 AND 23 09 33 FOR AUTOMATIC TEMPERATURE CONTROLS AND SEQUENCE OF OPERATION
7. PROVIDE 16 GAGE STEEL ENCLOSURE.
8. INDICATED HEATING CAPACITY IS THE SUM TOTAL BTUH FOR ALL TIERS OF MULTI-TIER ELEMENTS.
9. FURNISH WITH KNOB ADJUSTED DAMPER AT OUTLET.
10. INSTALL BARE ELEMENT BEHIND CASEWORK. PROVIDE CONTINUOUS 5" BAR GRILLE - PRICE MODEL LBPH 25C WITH TYPE 125 BORDER AT SILL AND BOTTOM FACE. REFER TO ARCHITECTURAL PLANS AND DETAILS.

AIR/DIRT SEPARATOR

SYMBOL	MANUFACTURER & MODEL	BODY DIA (INCHES)	PIPE CONNS QNTY x SIZE	HEIGHT (INCHES)	FLOW (GPM)	MAX WPD (FT HD)	TYPE	LOCATION	SYSTEM SERVED	NOTES
AS-1	SPROTHER+ SPROVENT QUAD - VXNS00	13	4 x 5"	70	334	2.5	COALESCING AIR/DIRT SEPARATOR HYDRAULIC DECOUPLER	MECHANICAL ROOM	HOT WATER	

1. PROVIDE (2) PRIMARY AND (2) SECONDARY FLANGED PIPE CONNECTIONS. REDUCE FROM MAIN PIPING AS REQUIRED.
2. FURNISH WITH COALESCING ELEMENT, INTEGRAL AIR VENT AND BLOWDOWN VALVE.

SUPPLY DIFFUSER/GRILLE SCHEDULE

TAG	NECK SIZE	TYPE	CFM	MAX TOTAL PRESSURE (IN. WG)	MAX NC	MAX NECK VEL (FPM)	MANUFACTURER & MODEL NO		NOTES
A	6x6	CEILING DIFFUSER	0-100	.10	17	500	KRUEGER	SSH	1,2,3,4,5
B	9x9	CEILING DIFFUSER	101-225	.10	17	500	KRUEGER	SSH	1,2,3,4,5
C	12x12	CEILING DIFFUSER	226-400	.15	17	500	KRUEGER	SSH	1,2,3,4,5
D	15x15	CEILING DIFFUSER	401-575	.15	17	500	KRUEGER	SSH	1,2,3,4,5
E	18x18	CEILING DIFFUSER	576-800	.15	17	500	KRUEGER	SSH	1,2,3,4,5
F	36X8	DUCT MOUNTED GRILLE	301-500.	.15	17	500	KRUEGER	DH36GR	---
G	36X4	DUCT MOUNTED GRILLE	101-300	.15	17	500	KRUEGER	DH36GR	---
H	12X4	DUCT MOUNTED GRILLE	0-100	.15		500	KRUEGER	DH36GR	
J	---	LINEAR SLOT	---	.15	17	500	KRUEGER	1210	6
K	14X8	SIDEWALL GRILLE	0-200	.02	17	500	KRUEGER	880.	5,6
L	12X8	SIDEWALL GRILLE	201-300	.02	17	500	KRUEGER	880.	5,6
M	30X16	SIDEWALL GRILLE	900-1030	.15	17	500	KRUEGER	880.	5,6
N	24X6	SIDEWALL GRILLE	301-400	.02	17	500	KRUEGER	880.	5,6
O	24X12	SIDEWALL GRILLE	401-700	.02	17	500	KRUEGER	880.	5,6
P	14	DUCT MOUNTED GRILLE	0-400	.02	17	500	KRUEGER	R-12PLQ	---
Q	8"	DUCT MOUNTED GRILLE	0-200	.02	17	500	KRUEGER	R-12PLQ	---
R	48X12	SIDEWALL GRILLE	800-1100	.02	17	500	KRUEGER	880.	5,6
S	48X8	DUCT MOUNTED GRILLE	0-700	.15	17	500	KRUEGER	DH36GR	---
T	36X16	SIDEWALL GRILLE	700-1350	.02	17	500	KRUEGER	880.	5,6

1. PROVIDE BORDER FOR LAY-IN, SURFACE MOUNTED OR DUCT MOUNTED AS REQUIRED.
2. DUCT RUNOUTS, DROPS AND FLEX DUCTS TO DIFFUSERS SHALL BE NECK SIZE OR EQUIVALENT.
3. PROVIDE TRANSITION FROM DUCT RUNOUT OR FLEX DUCT TO DIFFUSER NECK WHERE REQUIRED.
4. USE FLEXIBLE DUCT CONNECTIONS TO CEILING MOUNTED DIFFUSERS ONLY, LENGTH NOT TO EXCEED 5 FEET.
5. INSTALL DUCT VOLUME DAMPERS IN BRANCH DUCTS TO ALL DIFFUSERS.
6. SURFACE MOUNTED WITH SCREWED FLANGE.
7. PROVIDE SQUARE TO ROUND TRANSITIONS AS REQUIRED.
8. (1) 1" SLOT FRAME WIDTH 2-1/4"
9. COLOR TO MATCH CEILING. COORDINATE WITH ROOM FINISH SCHEDULE. SUBMIT COLOR SAMPLES FOR APPROVAL.

RETURN/EXHAUST GRILLE SCHEDULE

TAG	NECK SIZE	TYPE	CFM	MAX STATIC PRESSURE (IN. WG)	MAX NC	MANUFACTURER & MODEL		NOTES
R1	6x6	CEILING RETURN	0-99	.02	17	KRUEGER	AF5585	1,2,3
R2	8x8	CEILING RETURN	100-149	.02	17	KRUEGER	AF5585	1,2,3
R3	10X10	CEILING RETURN	150-249	.02	17	KRUEGER	AF5585	1,2,3
R4	12X12	CEILING RETURN	250-400	.02	17	KRUEGER	AF5585	1,2,3
R5	14x14	CEILING RETURN	401-500	.02	17	KRUEGER	AF5585	1,2,3
R6	16x16	CEILING RETURN	501-700	.02	17	KRUEGER	AF5585	1,2,3
R7	18x18	CEILING RETURN	701-900	.02	17	KRUEGER	AF5585	1,2,3
R8	24x24	CEILING RETURN	901-1300	.02	17	KRUEGER	AF5585	1,2,3
R9	30X12	SIDEWALL RETURN	700-850	.02	17	KRUEGER	880.	4
R10	30X8	DUCT MOUNTED RETURN GRILLE	401-500	.02	17	KRUEGER	DH36GR	4
R11	24X12	SIDEWALL RETURN	0- 700	.02	17	KRUEGER	5480	4
R12	6X4	SIDEWALL RETURN	0-250	.02	17	KRUEGER	5480	4
R13	52X8	SIDEWALL RETURN	0-1600	.02	17	KRUEGER	5480	4
R14	24X6	SIDEWALL RETURN	0-400	.02	17	KRUEGER	580	1,2,3
R15	52X12	SIDEWALL RETURN	0-2000	.02	17	KRUEGER	5480	4
R16	48x48	DUCT MOUNTED RETURN GRILLE	0-5600	.02	17	KRUEGER	5548GZ	4
R17	36X18	SIDEWALL RETURN	0-1340	.02	17	KRUEGER	5480	4
R18	52X12	CEILING RETURN	0-1600	.02	17	KRUEGER	AF5585	1,2,3
R19	88X30	DUCT MOUNTED RETURN GRILLE	0-1,600	.02	17	KRUEGER	5548GZ	4
E1	6x6	CEILING EXHAUST	0-99	.02	17	KRUEGER	580	1,2,3
E2	8x8	CEILING EXHAUST	100-149	.02	17	KRUEGER	580	1,2,3
E3	10X10	CEILING EXHAUST	150-249	.02	17	KRUEGER	580	1,2,3
E4	12x12	CEILING EXHAUST	250-400	.02	17	KRUEGER	580	1,2,3
E5	14x14	CEILING EXHAUST	401-500	.02	17	KRUEGER	580	1,2,3
E6	8X4	SIDEWALL EXHAUST	0-99	.02	17	KRUEGER	5480	4
E7	18X10	SIDEWALL EXHAUST	0-200	.02	17	KRUEGER	5480	4
E8	8X4	SIDEWALL EXHAUST	0-250	.02	17	KRUEGER	5480	4

NOTES:
1. FURNISH WITH FRAME AND BORDER FOR SURFACE MOUNTING OR LAY-IN AS REQUIRED.
2. DUCT RUNOUTS TO GRILLES SHALL BE NECK SIZE OR EQUIVALENT.
3. INSTALL DUCT VOLUME DAMPERS IN BRANCH DUCTS TO ALL DIFFUSERS.
4. SURFACE MOUNTED WITH SCREWED FLANGE.
5. COLOR TO MATCH CEILING. COORDINATE WITH ROOM FINISH SCHEDULE. SUBMIT COLOR SAMPLES FOR APPROVAL.

SOUND ATTENUATOR SCHEDULE–FAN COIL UNITS

TAG	TYPE	DIMENSIONS (inches)			AIR FLOW (CFM)	VELOCITY (FPM)	MAX. PD in wg	MAX. PD WITH SYS. EFF. in. wg.	MINIMUM DYNAMIC INSERTION LOSS, dB / MAXIMUM SELF GENERATED NOISE, dB / OCTAVE BAND CENTER FREQUENCY, HZ								BASIS OF DESIGN VIBRO-ACOUSTICS MODEL NUMBER	NOTES
		WIDTH OR DIA	HEIGHT	LENGTH					63	125	250	500	1000	2000	4000	8000		
SA1-A SA1-B	RED	24	10	72	1066	-443	0.06	0.12	5 44	11 32	22 25	39 28	50 31	46 22	29 11	18 10	RED-MLV-F9 - L9361	ELBOW
SA1-2A SA1-2B	RED	52	10	72	1100	-305	0.06	0.11	8 47	12 35	27 20	36 15	42 15	37 15	24 15	17 15	RED-ULV-F7 - L9361	ELBOW
SA2-2A, SA2-2B	RED	52	10	60	1600	-443	0.06	0.12	4 49	7 38	16 23	28 29	39 26	32 15	21 15	13 10	RD-LV-F9 - L9361	ELBOW
SA2-3A, SA2-3B	RED	52	10	60	1600	-443	0.02	0.04	4 43	6 40	14 34	23 30	25 17	19 15	13 15	9 10	RED-MV-F7 - L9361	ELBOW
SA3-1A, SA3-1B	RED	52	10	66	1130	-313	0.06	0.13	6 40	11 30	21 20	33 15	45 15	40 15	28 15	18 15	RED-ULV-F9 - L9361	ELBOW
SA3-1A, SA3-1B	RED	52	10	72	1130	-313	0.07	0.13	7 40	12 30	23 20	37 15	47 15	46 15	35 15	21 15	RED-ULV-F9 - L9361	ELBOW
SA3-2A, SA3-2B,	RED	52	10	60	1100	-305	0.03	0.06	4 40	7 30	16 20	28 15	39 15	32 15	21 15	13 15	RED-LV-F9 - L9361	ELBOW
SA5-1, SA5-2	RD	47	13	84	2000	-471	0.07	0.14	5 40	11 30	22 18	39 15	50 15	46 15	35 15	18 15	RD-MLV-F9 - L9361	STRAIGHT
SA5-3A, SA5-3B	RD	52	10	60	1100	-305	0.03	0.06	4 40	7 30	16 20	28 15	39 15	32 15	21 15	13 15	RD-LV-F9 - L9361	STRAIGHT
SA3-3C, SA3-3D	RD	46	8	60	1100	-313	0.07	0.13	7 40	12 30	23 20	37 15	47 15	46 15	35 15	21 15	RD-ULV-F9 - L9361	STRAIGHT
SA3-3A, SA3-3B,	RED	52	10	72	1100	-313	0.07	0.13	7 40	12 30	23 20	37 15	47 15	46 15	35 15	21 15	RED-ULV-F9 - L9361	ELBOW
SA3-3C, SA3-3D,	RD	46	8	60	1100	-313	0.07	0.13	7 40	12 30	23 20	37 15	47 15	46 15	35 15	21 15	RD-ULV-F9 - L9361	STRAIGHT

CABINET UNIT HEATER SCHEDULE

TAG	MANUFACTURER & MODEL	TYPE	CFM	HEATING CAPACITY					MOTOR		FILTERS	DIMENSIONS (INCHES)			HOT WATER SUP & RET (INCHES)	NOTES
				BTUH	GPM	EAT (°F)	EWT (°F)	MAX △PW (FT. HD)	HP	VOLTS/PH		L	H	D		
CUH-1	STERLING FSC13	VERTICAL SURFACE MOUNT SLOPE TOP	450	19,000	2.0	50	140	0.4	1/15	115/1	1/2 DISPOSABLE	43	25	9.5	3/4	1,2,3,4
CUH-2	STERLING RWC13	VERTICAL RECESSED	450	19,000	2.0	50	140	0.4	1/15	115/1	1/2 DISPOSABLE	43	25	9.5	3/4	1,2,3,4,5
CUH-3	STERLING RWC18	VERTICAL RECESSED	620	45,000	4.5	50	140	2.0	1/15	115/1	1/2 DISPOSABLE	59	25	9.5	3/4	1,2,3,4,5

NOTES:
1. FURNISH WITH MOTOR WITH INTERNAL THERMAL OVERLOAD PROTECTION.
2. FURNISH WITH FACTORY DISCONNECT SWITCH.
3. PROVIDE WITH FACTORY MOUNTED FAN AND TEMPERATURE CONTROL .
4. PROVIDE WITH FACTORY INSTALLED INTERNAL INSULATION.
5. FURNISH RECESSED UNITS WITH WALL SEAL KIT. COORDINATE REQUIRED WALL OPENINGS.

HOT WATER DUCT COIL SCHEDULE

SYMBOL	MANUFACTURER & MODEL	SIZE (L x W)	ROWS	MINIMUM HEATING CAPACITY (MBH)	CFM	GPM	EWT (DEG F)	LWT (DEG F)	EAT (DEG F)	LAT (DEG F)	MAX WPD (FT HD)	MAX APD (IN WG)	MAXIMUM FACE VELOCITY (FPM)	SERVICE	NOTES
HWC-1	CAPITAL COIL & AIR HOT WATER DUCT COIL	48 x 12	1	35.4	2050	3.3	140	118.2	70	86	5.0	0.09	515	FCU-B-1 REHEAT	
HWC-2	CAPITAL COIL & AIR HOT WATER DUCT COIL	48 x 12	1	35.4	2050	3.3	140	118.2	70	86	5.0	0.09	515	FCU-B-2 REHEAT	
HWC-3	CAPITAL COIL & AIR HOT WATER DUCT COIL	30 x 8	1	17.1	690	1.7	140	120	70	93	5.0	0.09	415	FCU-2-1 REHEAT	

NOTES:
1. PROVIDE DUCT TRANSITION FROM UNIT DISCHARGE TO COIL AS REQUIRED.

UNIT HEATER SCHEDULE

TAG	MANUFACTURER	CFM	HEATING CAPACITY						MOTOR		MODEL	NOTES
			MBH	GPM	EAT (°F)	LAT (°F)	EWT (°F)	LWT (°F)	HP	VOLTS/PH		
UH-1B	AREDALE	1775	39,392	9	60	80	120	111	2.9	1/6	115/1	MODEL WTC12S8015A	1,2,3,4

REMARKS:
1. FURNISH WITH MOTOR WITH INTERNAL THERMAL OVERLOAD PROTECTION.
2. DISCONNECT SWITCH SHALL BE PROVIDED BY DIVISION 26.
3. SEISMICALLY SUPPORT .
4. PROVIDE WITH WALL MOUNTED THERMOSTATS. THERMOSTATS SHALL BE MOUNTED ON INSULATED SUB-BASES.

HIGH EFFICIENCY CONDENSING BOILER SCHEDULE

SYMBOL	INPUT (MBH)	GROSS IBR OUTPUT (MBH)	WATER FLOW (GPM)	BOILER Cv	SUPPLY WATER TEMP (°F)	RETURN WATER TEMP (°F)	BURNER					ELECTRICAL		THERMAL EFFICIENCY	MANUFACTURER & MODEL	NOTES
							FUEL	GAS PRESSURE (IN.WG)	CAPACITY CONTROL	TURNDOWN RATIO	IGNITION	VOLTS/PHASE	AMPS			
B-1	3000	2781	278	278	140	120	NAT. GAS	3 - 14	MODULATING	51	DIRECT SPARK	208V/3PH	8.3	92.7%	HYDROTHERM KN30	1,2,3,4,5
B-2	3000	2781	278	278	140	120	NAT. GAS	3 - 14	MODULATING	51	DIRECT SPARK	208V/3PH	8.3	92.7%	HYDROTHERM KN30	1,2,3,4,5

1. PROVIDE WITH FACTORY HEATNET BACNET CONTROLLER FOR CONTROL INTERFACE WITH NEW BUILDING MANAGEMENT SYSTEM.
2. FURNISH EACH BOILER AND VENT WITH CONDENSATE NEUTRALIZATION TANK EQUAL TO JF1-30.
3. MINIMUM FLOW THROUGH BOILERS SHALL BE 45 GPM.
4. BOILER TO BE SHIPPED KNOCKED DOWN FOR FIELD ASSEMBLY. CONTRACTOR SHALL ASSEMBLE BOILER IN FIELD AS REQUIRED BY BOILER ROOM ACCESS CLEARANCES.
5. INSTALL BOILER ON 4" REINFORCED CONCRETE PAD, ON 1/4 INCH STATIC DEFLECTION SPRING ISOLATORS.

Project Title:
Expansion and Alterations to:
WEST SHORE MIDDLE SCHOOL
70 Kay Avenue, Milford CT 06460

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Revision:	Description:	Date:	Revised By:
1	ADDENDUM #1	11/1/2018	JP

Drawing Title:
MECHANICAL SCHEDULES

State Project Number: TMP-084-JLGB

Date: 8-18-2018
Scale: 1/8" = 1'-0"
Drawn By: Author
Project Number: 14-278

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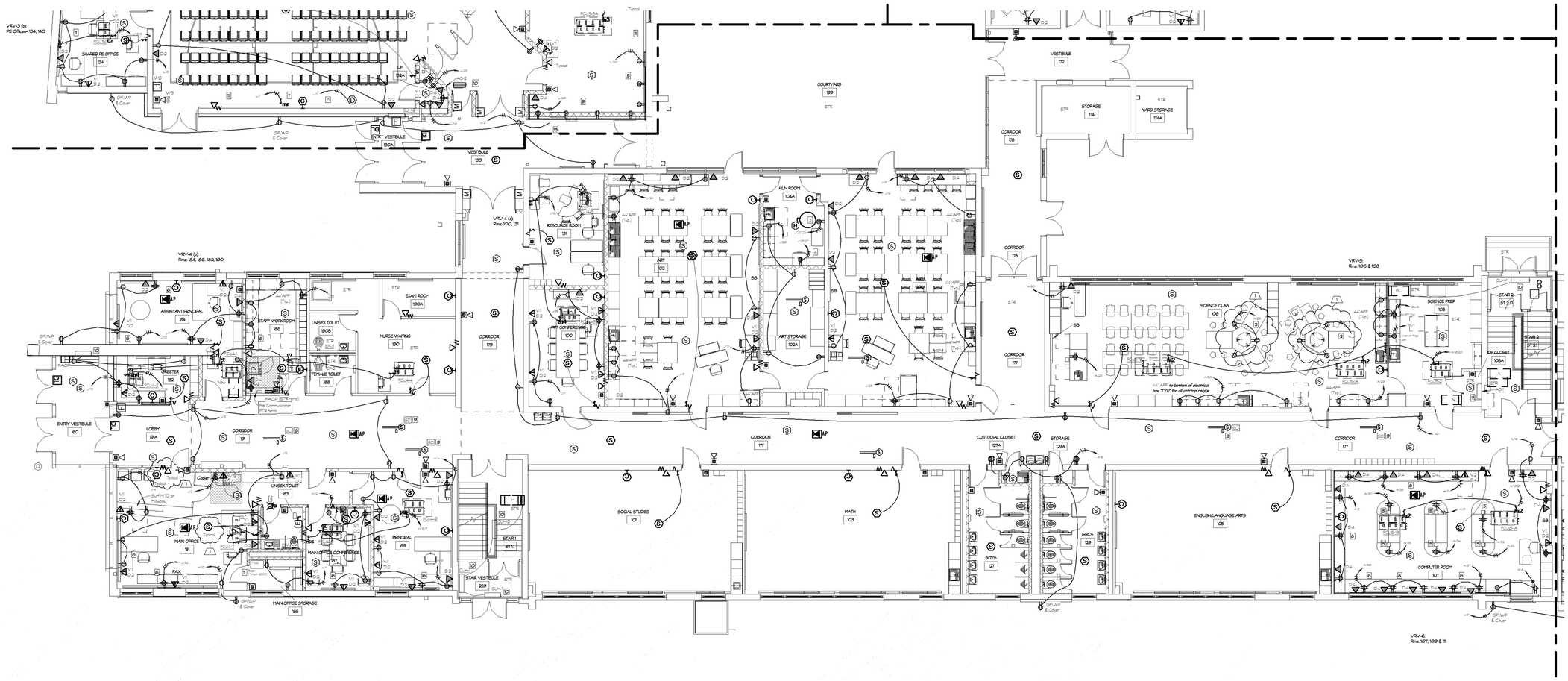
M402



1 / E201 Main Level Power Plan - Part A
SCALE: 1/8" = 1'-0"

POWER NOTES PART A

1. PROVIDE A COMPLETE HANDICAP CALL FOR AID SYSTEM, WIRE SYSTEM TO ROOM RECEPTACLE BRANCH CIRCUIT.
   USE AUTHENTIC PARTS OR EQUAL.
   PULL CORD STATION - (208-2)
   DOME LIGHT WITH BUZZER - (3202-2C)
   REMOTE BUZZER - (110).
2. ELECTRICAL CONTRACTOR SHALL PROVIDE WIRES AND CONDUIT FROM SCIENCE TABLE TO THE APPROPRIATE PANEL. HORIZONTAL MOUNT TIGHT TO COUNTERTOP. PROVIDE TRENCH IN THE CONCRETE FLOOR FOR THE HOME RUNS TO THE CLOSEST ROOM WALL.
3. PROVIDE APPROPRIATE NEMA RECEPTACLE TO MATCH EXISTING FOR RampMaster II, Evenheat Kiln, RELOCATED (50AMPS, 250V/1PH/2P, 3 WIRES, 6-50R), VERIFY IN FIELD FOR DETAILS.
4. LOW TEMPERATURE OVEN (208V/1PH/2P, 17A). COORDINATE WITH OWNER, PRIOR INSTALLATION, OVEN SPECIFICATION ELECTRICAL DATA AND THE RECEPTACLE BRANCH CIRCUIT WIRES.
5. ELECTRICAL CONTRACTOR SHALL FURNISH AND INSTALL TELE-POWER POLES FOR POWER AND DATA CONNECTIVITY IN THIS CLASSROOM AREA. USE HUBBELL CUSTOM MADE POLES, MODEL HUBBELL WIRING DEVICE-KELLEMS OR APPROVED EQUAL. EQUIPPED WITH TWO-CHANNEL (TWO CIRCUITS) FOR 6 (SIX) DUPLEX RECEPTACLE AND (6) SIX DATA COMPUTER PORTS. COORDINATE THE HEIGHT OF TELE- POWER POLES AND SIZES WITH FURNITURE AND MANUFACTURER, PRIOR THE ORDER. USE DATA CAT6A CABLE. (COORDINATE WITH OWNER AND INTERIOR DESIGNER FOR SMITH SYSTEM MODEL #17280 FOR 10 POST, IF WIFI TECHNOLOGY). PROVIDE TRENCH IN THE CONCRETE FLOOR FOR HOMERUNS TO THE CLOSEST WALL. COORDINATE IN FIELD. COLOR BY ARCHITECT.
6. ELECTRICAL CONTRACTOR SHALL INSTALL ALL THE RECEPTACLES ON THE EXTERIOR WALL, WHERE FIN TUBE RADIATORS ARE, AT 24.6" AFF TO DEVICE COVER PLATE OR MOUNT HORIZONTALLY, IF NEED IT. COORDINATE IN FIELD WITH MECHANICAL CONTRACTOR (FTR UNITS).
7. PROVIDE POWER, 208V/1PH, WIRES AND CONDUITS FROM AC UNIT TO ASSOCIATED CU UNIT, LOCATED ON ROOFTOP. COORDINATE WITH MECHANICAL DUCTLESS SPLIT SYSTEM AIR CONDITIONING SCHEDULE. REFER TO ELECTRICAL MAIN POWER PLAN.
   (AC-1/CU-10, AC-2/CU-11, AC-3/CU12 AND AC-4/CU-13).
8. ELECTRICAL CONTRACTOR SHALL FURNISH AND INSTALL DUAL-CHANNEL SURFACE RACEWAY (WIREMOLD AL4750 SERIES ALUMINUM OR EQUAL) AT 24.6" AFF (ABOVE FIN TUBE RADIATION) TO SERVE COMPUTER DESKS. VERIFY IN FIELD THE EXACT HEIGHT WITH CASEWORK. COORDINATE WITH OWNER AND ARCHITECTS PRIOR THE INSTALLATION. PROVIDE 2 EMT IN WALL FOR DATA AND 1 FOR POWER TO DIVIDED OR MULTIPLE BACKBONES. PROVIDE ALL REQUIRED END FITTINGS, ELBOWS, FACEPLATES, BRACKETS & HARDWARE TO SERVE DEVICES SHOWN. PROVIDE COLOR TO MATCH ARCHITECTURAL WALL BASE.
9. INSTALL DUCT SMOKE DETECTOR INSIDE FIRE DAMPER. COORDINATE EXACT LOCATION WITH MECHANICAL CONTRACTOR.
10. PROVIDE CIRCUIT 120V/1P, WIRES AND CONDUITS, FROM AREA RECEPTACLE CIRCUIT OR CLOSEST PANELBOARD, FOR POWER TO CABINET UNIT HEATER, CUH.
11. PROVIDE NEW IT RACK AND PUBLIC ANNUNCIATOR BOSEN MULTICOM 2000, LOCATION SHALL BE IN THE MAIN OFFICE AREA, AS SHOWN. COORDINATE IN FIELD WITH OWNER.

IMPORTANT NOTES:

1) ELECTRICAL CONTRACTOR SHALL COORDINATE IN FIELD EXACT LOCATION OF THE FIRE ALARM DEVICES AND ALL WALL SWITCHES WITH CASEWORKS, FURNITURE OR OTHER MECHANICAL EQUIPMENTS.

2) EACH FCU WILL BE FACTORY FURNISHED WITH A DISCONNECT SWITCH . EACH ROOM SHOULD BE PROVIDED BY MECHANICAL CONTRACTOR WITH A SELECTOR BOX SWITCH (Sss) TO SERVE THE UNITS IN THE ROOM, ABOVE THE CEILING. COORDINATE LOCATION WITH MECHANICAL DRAWINGS. THE SELECTOR BOX SHALL BE CONNECTED TO THE SAME CIRCUIT OF THE DISCONNECT SWITCHES. AHEAD OF THE DISCONNECT - TO DO THE FUTURE SERVICE TO EACH INDIVIDUAL UNIT, SO THE SWITCH WILL BE POWERED FOR OTHER FCU UNITS. (TYPICAL FOR VRV-1, VRV-2, VRV-3, VRV-4,VRV-7, VRV-8 AND VRV-9).

3) $m2 - motor rated disconnect switch for MCA: 2.8 to 3.4Amps
   $m3 - motor rated disconnect switch for MCA: 0.3 to 0.8Amps
   $m4 - motor rated disconnect switch for MCA: 1.4 to 1.8Amps
   $m5 - motor rated disconnect switch for MCA: 9.0Amps

4) WHERE ON WALL ARE FINNED TUBE ENCLOSURES, THE RECEPTACLES SHALL BE INSTALLED 24" AFF. COORDINATE WITH MECHANICAL DRAWINGS.

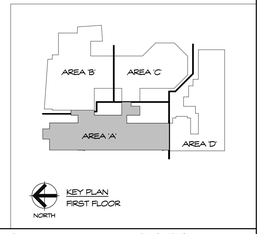
5) COUNTERTOP GFCI RECEPTACLES SHALL BE MOUNTED 44" AFF, TO THE BOTTOM OF ELECTRICAL BOX "TYP". COORDINATE EXACT LOCATIONS WITH FPE DRAWINGS.

6) RE-FEED ETR (Existing To Remain) PANELS FROM BASEMENT EXISTING MDP, TO NEW MDP - INCLUDING LP8K BASEMENT PANEL, ELEVATOR, MECHANICAL PUMPS, H.V. HEATERS AND FANS OR OTHER LOADS. ADD NEW LOAD TO ETR PANELS AND DISCONNECT WHERE NO LONGER USE, BACK TO SOURCE.

7) PROVIDE POWER, 120V/1P, FROM AREA RECEPTACLE CIRCUIT TO EF-1 R= 9.3, EF-2 R= 1.8, EF-3 R= 19.08 AND KILN R= 12.4A, AI IN AREA A. PROVIDE SPEED CONTROL SWITCH AND INTERLOCK WITH LIGHTING SWITCH ROOM. PROVIDE WALL SWITCH FOR EF-1. COORDINATE DETAILS WITH MECHANICAL CONTRACTOR.

8) PROVIDE TELECOMMUNICATION GROUNDING BUSBARS TO ALL IDF ROOMS, PER DIVISION 27 SPECIFICATIONS. CONNECT IDF ROOMS GND BUSBARS TO MDF ROOM MAIN GND BUSBAR. COORDINATE IN FIELD FOR DETAILS WITH A/V CONTRACTOR MANAGER.

9) PROVIDE ALL FIRE ALARM PULL STATIONS WITH COVERS.



Project Title:

Expansion and Alterations to:

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70 Kay Avenue, Milford CT 06460

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Revision:	Description:	Date:	Revised By:
1	Addendum #1	11/11/2016	MS

Revision:	Description:	Date:	Revised By:

Drawing Title:

POWER PLAN PART A

State Project Number: TMP-084-JLGB

Date: 8/18/2016

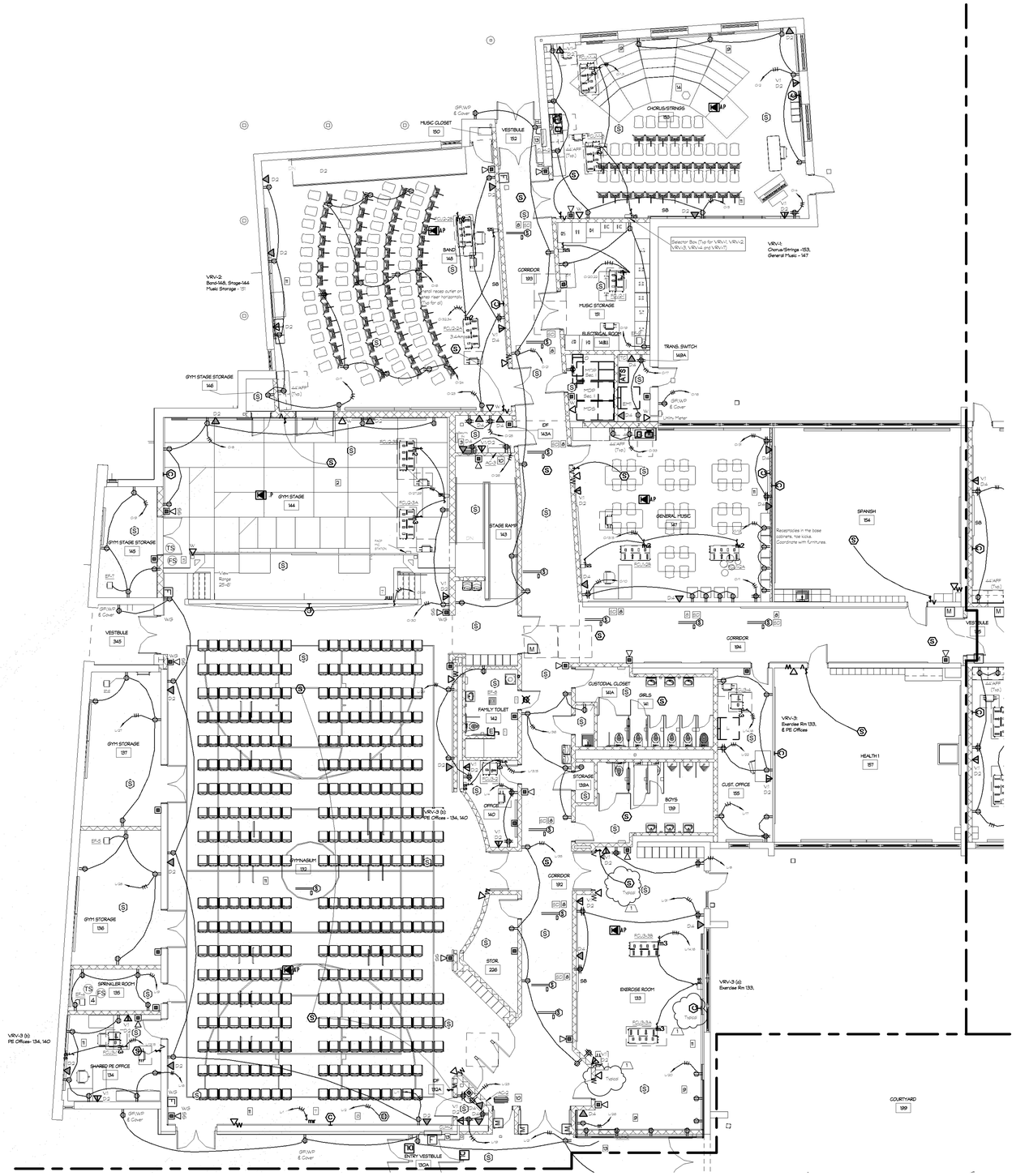
Scale: 1/8" = 1'-0"

Drawn By: MSantos - Electr. Engineer

Project Number: 14-278

Drawing Number:

E201



1 Main Level Power Plan - Part B
E223 SCALE: 1/8" = 1'-0"

POWER NOTES PART B

1. PROVIDE A COMPLETE HANDICAP CALL FOR AID SYSTEM, WIRE SYSTEM TO ROOM RECEPTACLE BRANCH CIRCUIT.
   USE AUTHENTIC PARTS OR EQUAL:
   PULL CORD STATION - (2026-2)
   DOME LIGHT WITH BUZZER - (3202-20)
   REMOTE BUZZER - (1701)
2. PROVIDE A SMOKE DETECTOR NEAR THE VENTS AND RELAY FOR VENTS (IN THE GYM STAGE 144) TO RELEASE OR OPEN THEM, FOR SMOKE EVACUATION.
3. COORDINATE THE MODEL AND FINAL LOCATION OF SECURITY PANEL, ELECTRICAL ROOM 148, AS WELL AS OTHER BOOSTER PANELS TYPES WITH OWNER AND SECURITY CONTRACTOR. PROVIDE GENERAL RECEPTACLE IF NEED IT.
4. PROVIDE FIRE ALARM MODULES FOR EACH FIRE PROTECTION TAMPER AND FLOW SWITCH. FOUR (4) TS's AND (1) FS FOR FIRE SERVICE ENTRANCE AND (2) TS's AND (1) FS FOR FUTURE WET PIPE FEED MAIN. COORDINATE QTY AND LOCATION WITH FIRE PROTECTION CONTRACTOR AND FIRE MARSHAL. WIRE TO FIRE ALARM SYSTEM. REFER TO E303 FA RISER & GEN NOTES ELEC. AND FP301 DRAWINGS FOR DETAILS.
5. PROVIDE FIRE ALARM MODULES FOR EACH FIRE PROTECTION TAMPER AND FLOW SWITCH. (2) SETS, ONE FOR STAGE STEM PIPE AND ONE FOR SPRINKLER ZONE. SAME AS NOTE #4 ABOVE.
6. PROVIDE BOX, OUTLET CEILING RECEPTACLE AND COVER FOR SCOREBOARD, WIRES AND CONDUIT TO PANEL L. POWER CORD IS SUPPLIED BY NEVCO INTO THE TOP OF SCOREBOARD. ALONG WITH WIRELESS RECEIVER (MPOW OR MPC-X2) FOR SCOREBOARD MODEL 2770. (8) AMPS AT 120V OR EQUAL.
7. FURNISH AND INSTALL DISCONNECT SWITCHES (SW) FOR MOTORIZED BASKETBALL HOOPS, MOUNTED HIGH ON THE WALL OR CEILING, CLOSE TO THE MOTOR. PROVIDE J-BOXES WITH COVERS, DEDICATED BRANCH CIRCUITS (IF 3-4HP, 13.8 AMPS/120VAC, WITH 20AMPS DISCONNECT SWITCH, INDUSTRIAL MOTOR RATED SWITCH OR EQUAL). WIRES AND CONDUITS. PROVIDE RETRACTABLE HOOP MOTOR KEY SWITCH. VERIFY WITH MANUFACTURER. PROVIDE 3-WAY CIRCUIT FOR ACTIVATING FROM BOTH DOOR ENTRANCES. MOUNT THE KEY SWITCHES ON EACH SIDE AT 48" AFF ON THE WALL PAD, (PENETRATE THE WALL PAD) AND LABEL THE SWITCH. COORDINATE LOCATION IN FIELD.
8. INSTALL DUCT SMOKE DETECTOR INSIDE FIRE DAMPER. COORDINATE EXACT LOCATION WITH MECHANICAL CONTRACTOR.
9. ELECTRICAL CONTRACTOR SHALL FURNISH AND INSTALL IN THE EXERCISE ROOM 133, WIREMOLD MULTIPLE OUTLET RACEWAY, TYPE PLUSMOLD 2000 SERIES (STEEL, SINGLE -CHANNEL) OR EQUAL. THE RACEWAY BASE IS 1.9/32" WIDE AND HAVE TO BE MOUNTED IMMEDIATELY ABOVE THE 8' WALL BASE MOLDING. PROVIDE ALL REQUIRED END FITTINGS, ELBOWS, FACEPLATES, BRACKETS & HARDWARE TO SERVE DEVICES SHOWN. REFER TO SPEC 260533 FOR OTHER MATERIAL REQUIREMENTS. PROVIDE COLOR TO MATCH ARCHITECTURAL WALL BASE. CONSULT FACTORY. CUSTOM COLOR OPTIONS ARE AVAILABLE. REFER TO ARCHITECTURAL DRAWINGS.
10. PROVIDE POWER, 208V/1PH, WIRES AND CONDUITS FROM AC UNIT TO ASSOCIATED CU UNIT, LOCATED ON ROOFTOP. COORDINATE WITH MECHANICAL DUCTLESS SPLIT SYSTEM AIR CONDITIONING SCHEDULE. REFER TO ELECTRICAL MAIN POWER PLAN. (AC-1/CU-1, AC-2/CU-1, AC-3/CU-2 AND AC-4/CU-13).
11. COORDINATE ALL GYM DEVICES WITH WALL PADS.
12. ELECTRICAL CONTRACTOR SHALL INSTALL ALL THE RECEPTACLES ON THE EXTERIOR WALL, WHERE FIN TUBE RADIATORS ARE, AT 24.6" AFF TO DEVICE COVER PLATE OR MOUNT HORIZONTALLY, IF NEED IT. COORDINATE IN FIELD WITH MECHANICAL CONTRACTOR (FTR UNITS).
13. PROVIDE CIRCUIT 120V/1P, WIRES AND CONDUITS, FROM AREA RECEPTACLE CIRCUIT OR CLOSEST PANELBOARD, FOR POWER TO CABINET UNIT HEATER, CUH.
14. PROVIDE CEILING MOUNT BREAK GLASS DETECTOR COMPATIBLE WITH EXISTING SECURITY SYSTEM. COORDINATE WITH SECURITY CONTRACTOR.

IMPORTANT NOTES:

1) ELECTRICAL CONTRACTOR SHALL COORDINATE IN FIELD EXACT LOCATION OF THE FIRE ALARM DEVICES AND ALL WALL SWITCHES WITH CASEWORKS, FURNITURE OR OTHER MECHANICAL EQUIPMENTS.

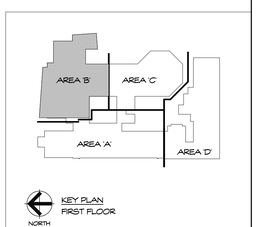
2) EACH RCU WILL BE FACTORY FURNISHED WITH A DISCONNECT SWITCH . EACH ROOM SHOULD BE PROVIDED BY MECHANICAL CONTRACTOR WITH A SELECTOR BOX SWITCH (Sw) TO SERVE THE UNITS IN THE ROOM, ABOVE THE CEILING. COORDINATE LOCATION WITH MECHANICAL DRAWINGS. THE SELECTOR BOX SHALL BE CONNECTED TO THE SAME CIRCUIT OF THE DISCONNECT SWITCHES, AHEAD OF THE DISCONNECT - TO DO THE FUTURE SERVICE TO EACH INDIVIDUAL UNIT, SO THE SWITCH WILL BE POWERED FOR OTHER RCU UNITS. (TYPICAL FOR VRV-1, VRV-2, VRV-3, VRV-4, VRV-7, VRV-8 AND VRV-9).

3) THE GYM RTU WILL BE FURNISHED WITH SINGLE POINT POWER CONNECTION AND FACTORY DISCONNECT SWITCHES. ELECTRICAL CONTRACTOR TO PROVIDE AND CONNECT WIRES, CONDUITS AND APPROPRIATE PANEL CIRCUIT BREAKERS. COORDINATE WITH MECHANICAL CONTRACTOR.

4) $m2 - motor rated disconnect switch for MCA 2.8 to 3.4Amps
   $m3 - motor rated disconnect switch for MCA 0.3 to 0.8Amps
   $m4 - motor rated disconnect switch for MCA 1.4 to 1.8Amps
   $m5 - motor rated ds disconnect for MCA 9.0Amps
   $mr - motor rated ds disconnect for motorized hoops.

5) PROVIDE POWER, 120V/1P, FROM AREA RECEPTACLE CIRCUIT, TO EF-4 Rm 135, EF-5 GYM STG 136, EF-6 GYM STG 137, EF-7 GYM STG 145, EF-8 Rm 142 AND EF-9 Rm 151, ALL IN AREA B. PROVIDE SPEED CONTROL SWITCH TO EF-8 AND INTERLOCK WITH THERMOSTAT. COORDINATE WITH MECHANICAL CONTRACTOR.

6) PROVIDE ALL FIRE ALARM PULL STATIONS WITH COVERS.



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Drawing Title:
POWER PLAN PART B

State Project Number: TMP-084-JLGB

Date: 8-18-2018
Scale: 1/8" = 1'-0"
Drawn By: MSpinzo - Electr. Engineer
Project Number: 14.278
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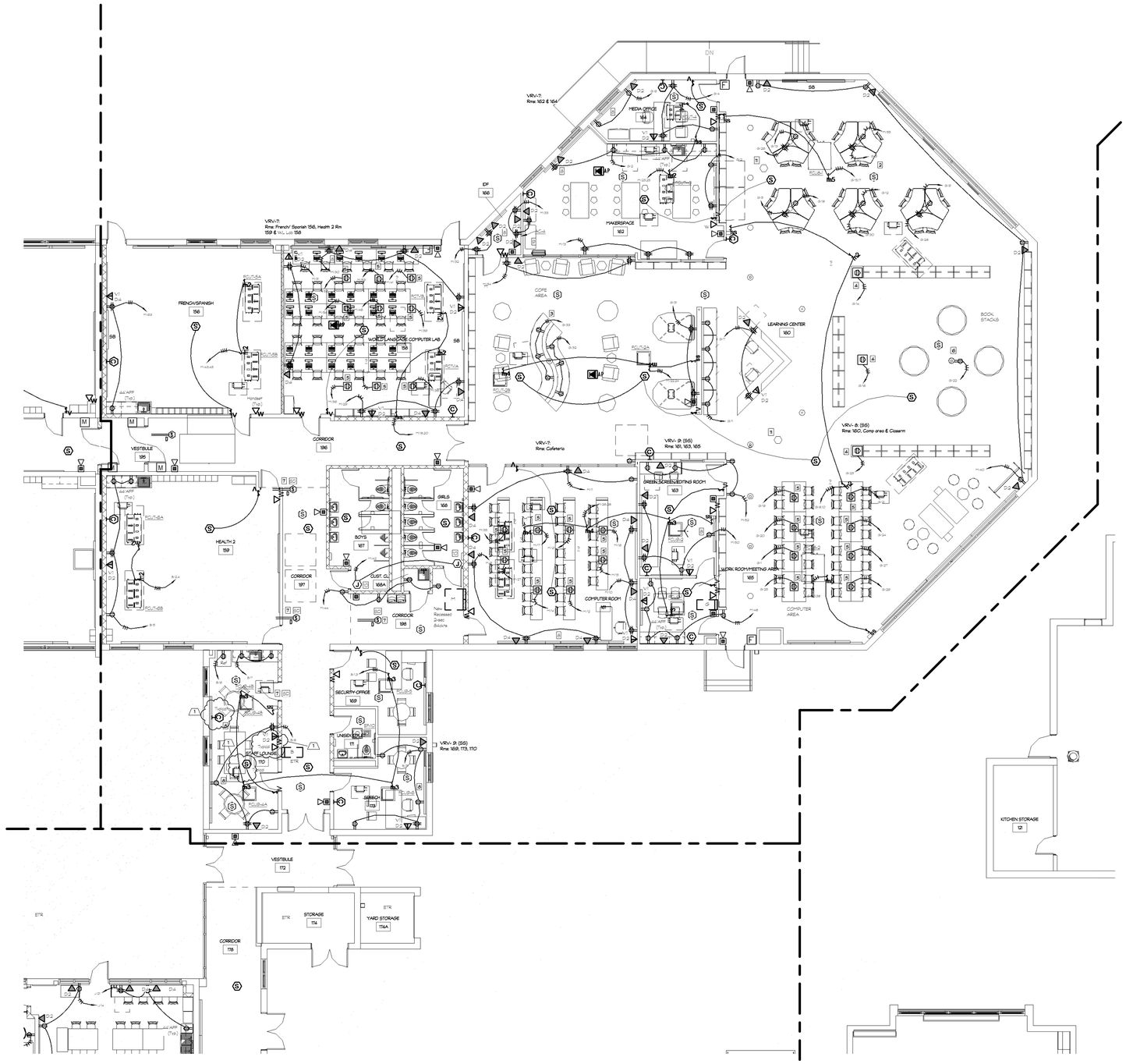


1 / E203 Main Level Power Plan - Part C
SCALE: 1/8 = 1'-0"

POWER NOTES PART C

1 PROVIDE A COMPLETE HANDICAP CALL FOR AID SYSTEM. WIRE SYSTEM TO ROOM RECEPTACLE BRANCH CIRCUIT.
USE AUTHENTIC PARTS OR EQUAL.
PULL CORD STATION - (2068-2)
DOME LIGHT WITH BUZZER - (3022-2C)
REMOTE BUZZER - (110)

2 ELECTRICAL CONTRACTOR SHALL FURNISH AND INSTALL TELE-POWER POLES FOR POWER AND DATA CONNECTIVITY IN THIS CLASSROOM AREA.
USE HUBBELL CUSTOM MADE POLES, MODEL HUBBELL WIRING DEVICE-KELLEMS OR APPROVED EQUAL. EQUIPPED WITH TWO-CHANNEL (TWO CIRCUITS) FOR 8 (SIX) DUPLEX RECEPTACLE AND (8) SIX DATA COMPUTER PORTS. COORDINATE THE HEIGHT OF TELE- POWER POLES AND SIZES WITH FURNITURE AND MANUFACTURER. PRIOR THE ORDER. USE DATA CAT6A CABLE. (COORDINATE WITH OWNER AND INTERIOR DESIGNER FOR SMITH SYSTEM MODEL #17080 FOR I-O POST. IF WIFI TECHNOLOGY). PROVIDE TRENCH IN THE CONCRETE FLOOR FOR HOMERUNS TO THE CLOSEST WALL. COORDINATE IN FIELD.
COLOR BY ARCHITECT.

3 ELECTRICAL CONTRACTOR TO PROVIDE WALL RECEPTACLE OUTLETS FOR THESE TABLES, WIRES AND CONDUITS.

4 ELECTRICAL CONTRACTOR TO PROVIDE FLOOR POWER DUPLEX RECEPTACLES AND DATA OUTLETS. WIRES AND CONDUITS FOR MOBILE INTERACTIVE BOARD AND TWO COMPUTER STATIONS IN BOOK STACK AREA. PROVIDE TRENCH IN THE CONCRETE FLOOR FOR THE HOME RUNS. USE WIREMOLD, LEGRAND, OMNIBOX CAST IRON FLOOR BOX, TWO-GANG, P/N: 880CS2-1, WITH TWO-GANG BRASS CARPET FLANGE, P/N: 2-7C, AND DUPLEX BRASS COVER 828R TILIP LIDS. COORDINATE WITH OWNER AND INTERIOR DESIGNER IN FIELD FOR EXACT LOCATION.

5 ELECTRICAL CONTRACTOR TO PROVIDE (2) TWO-GANG FLOOR BOXES FOR EVERY TWO FLEX TABLE (EACH TABLE EQUIPPED WITH (4) RECEPTACLE SINGLE OUTLET, AND (2) TWO DATA OUTLETS)
ONE GANG BOX SHALL HAVE A DUPLEX POWER RECEPTACLE AND ONE GANG BOX (4) FOUR DATA OUTLETS.
PROVIDE TRENCH IN THE CONCRETE FLOOR FOR THE HOME RUNS- SEE NOTE 4 BELOW. USE WIREMOLD, LEGRAND, OMNIBOX CAST IRON RECEPTACLE FLOOR BOX P/N: 880CS2-1, FLANGE P/N: 8TTCAL AND (1) ONE DUPLEX COVER P/N:828R-TCAL FOR RECEPTACLE COMPARTMENT AND (1) ONE COMMUNICATION COVER PLATE P/N: 828SFTCAL. FOR (4) FOUR DATA OUTLETS.

6 PROVIDE POWER, 120V/1P/1PH. WIRES AND CONDUIT ONTO THE COLUMN. COORDINATE IN FIELD THE HEIGHT WITH OWNER AND FURNITURE. PROVIDE SURFACE MOUNT BOX, BRACKETS AND DEVICES AS NECESSARY.

7 INSTALL DUCT SMOKE DETECTOR INSIDE FIRE DAMPER. COORDINATE EXACT LOCATION WITH MECHANICAL CONTRACTOR.

8 ELECTRICAL CONTRACTOR SHALL INSTALL ALL THE RECEPTACLES ON THE EXTERIOR WALL WHERE FIN TUBE RADIATORS ARE, AT 24.6" AFF TO DEVICE COVER PLATE OR MOUNT HORIZONTALLY, IF NEED IT. COORDINATE IN FIELD WITH MECHANICAL CONTRACTOR (FRT UNITS).

9 PROVIDE POWER 208V/1PH. WIRES AND CONDUITS FROM AC UNIT TO ABSOCIATED CU UNIT, LOCATED ON ROOFTOP. COORDINATE WITH MECHANICAL DUCTLESS SPLIT SYSTEM AIR CONDITIONING SCHEDULE. REFER TO ELECTRICAL MAIN POWER PLAN. (AC-1/CU-1C, AC-2/CU-1, AC-3/CU-2 AND AC-4/CU-3).

10 PROVIDE POWER 120V/1PH/1P TO JUNCTION BOXES, WIRES, CONDUITS, ABOVE CEILING FOR POWER DOOR OPERATOR. IN BATH ROOMS 167 AND 168.

11 PROVIDE CEILING MOUNT BREAK GLASS DETECTOR COMPATIBLE WITH EXISTING SECURITY SYSTEM. COORDINATE WITH SECURITY CONTRACTOR.

IMPORTANT NOTES:

1) CONTRACTOR SHALL COORDINATE IN FIELD EXACT LOCATION OF THE FIRE ALARM DEVICES AND ALL WALL SWITCHES WITH CASEWORKS, FURNITURE OR OTHER MECHANICAL EQUIPMENTS.

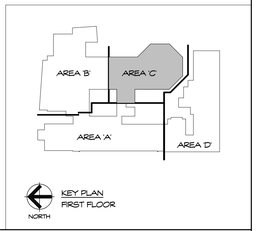
2) EACH FCU WILL BE FACTORY FURNISHED WITH A DISCONNECT SWITCH . EACH ROOM SHOULD BE PROVIDED BY MECHANICAL CONTRACTOR WITH A SELECTOR BOX SWITCH (See) TO SERVE THE UNITS IN THE ROOM. ABOVE THE CEILING. COORDINATE LOCATION WITH MECHANICAL DRAWINGS. THE SELECTOR BOX SHALL BE CONNECTED TO THE SAME CIRCUIT OF THE DISCONNECT SWITCHES. AHEAD OF THE DISCONNECT - TO DO THE FUTURE SERVICE TO EACH INDIVIDUAL UNIT. SO THE SWITCH WILL BE POWERED FOR OTHER FCU UNITS. (TYPICAL FOR V.R.V.-1, V.R.V.-2, V.R.V.-3, V.R.V.-4, V.R.V.-7, V.R.V.-8 AND V.R.V.-9).

3) S#-2 - motor rated disconnect switch for MCA 2.8 to 3.4 Amps
S#-3 - motor rated disconnect switch for MCA 0.3 to 0.6 Amps
S#-4 - motor rated disconnect switch for MCA 1.4 to 1.8 Amps
S#-5 - motor rated disconnect switch for MCA 9.0 Amps

4) ELECTRICAL CONTRACTOR SHALL FURNISH AND INSTALL FOR ALL FLOOR BONES, 3/4" EMPTY CONDUIT WITH DRASLINE IN CONCRETE SLAB FOR POWER AND ONE 1 1/4" FOR DATA. STUB UP IN DRYWALL COLUMN AND EXTEND TO ABOVE NEAREST ACCESSIBLE CEILING. PROVIDE ANTI-SHORT BUSHING ON CONDUIT TERMINATION ABOVE THE CEILING. COORDINATE EXACT LOCATIONS WITH FURNITURE.
ELECTRICAL CONTRACTOR SHALL FURNISH AND INSTALL 3/4" EMPTY CONDUIT WITH DRASLINE IN CONCRETE SLAB FOR POWER AND ONE 1 1/4" FOR DATA. STUB UP IN DRYWALL COLUMN AND EXTEND TO ABOVE NEAREST ACCESSIBLE CEILING. PROVIDE ANTI-SHORT BUSHING ON CONDUIT TERMINATION ABOVE THE CEILING. ALL WIRES SHALL BE ROUTING TO THE APPROPRIATE IT RACK (ROOM(S). COORDINATE EXACT LOCATIONS WITH FURNITURE AND IT CONTRACTOR FOR OTHER DETAILS. THE RACKS BY ELECTRICAL CONTRACTOR.
ELECTRICAL CONTRACTOR SHALL FURNISH AND INSTALL WIREMOLD FLOOR BONES TO MEET NEC 2011 REQUIREMENTS ARTICLE 314.27(B) AND UL514A. COORDINATE WITH IT CONTRACTOR AND OWNER FOR OTHER DEVICES.

5) PROVIDE POWER, 120V/1P, FROM AREA RECEPTACLE CIRCUIT, TO EF-1D RM 171 IN AREA C PROVIDE SPEED CONTROL SWITCH AND INTERLOCK WITH LIGHTING SWITCH. COORDINATE WITH MECHANICAL CONTRACTOR.

6) PROVIDE ALL FIRE ALARM PULL STATIONS WITH COVERS.



Project Title:
Expansion and Alterations to:
WEST SHORE MIDDLE SCHOOL
70 Kay Avenue, Milford CT 06460

SILVER / PETRUCELLI + ASSOCIATES
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1	Addendum #1	11/11/2016	MS

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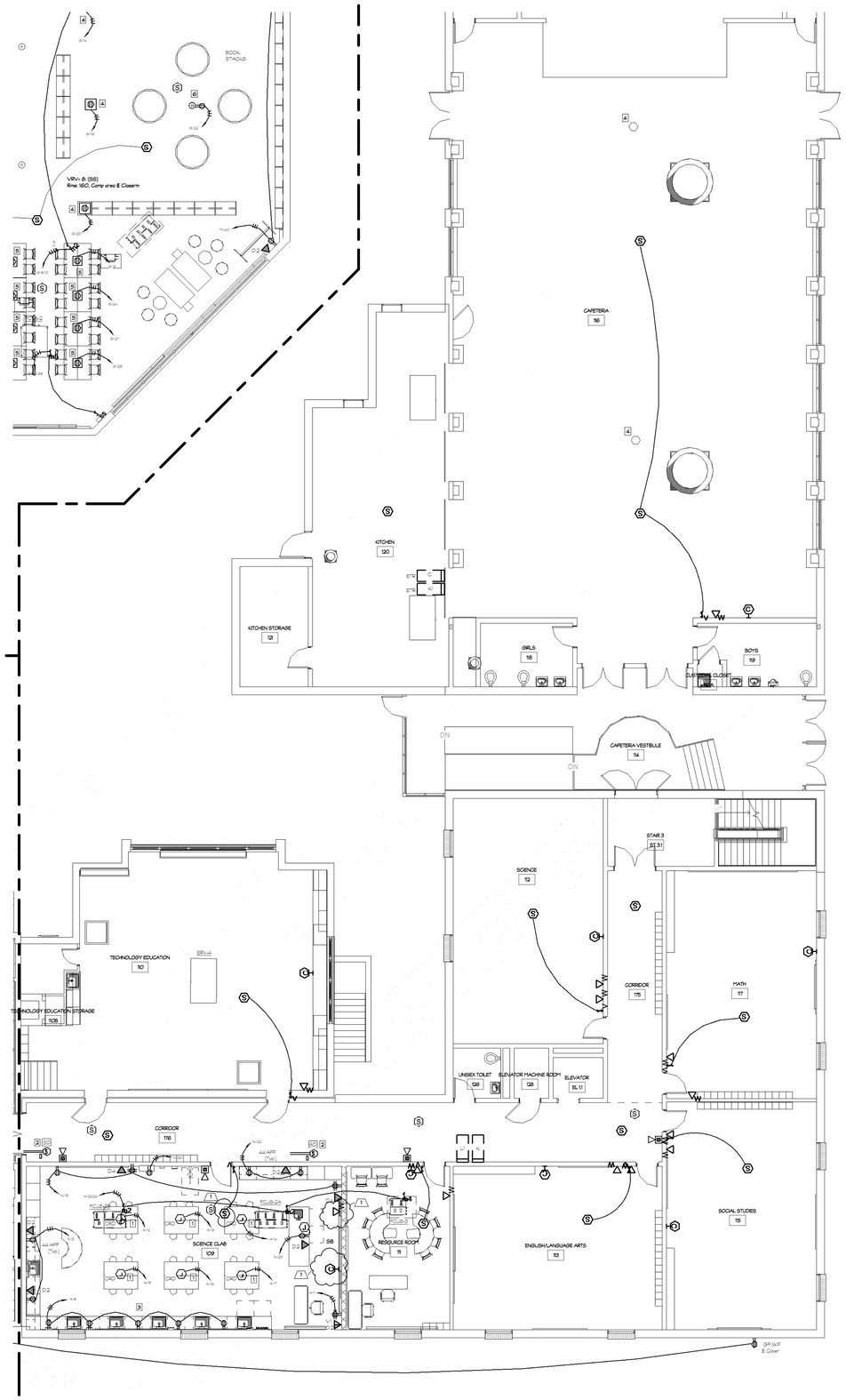
Drawing Title:
POWER PLAN PART C

State Project Number: TMP-084-JLGB

Date: 8/18/2016
Scale: 1/8 = 1'-0"
Drawn By: MSantos - Elect. Engineer
Project Number: 14-278

Drawing Number:
E203



1 Main Level Power Plan - Part D
E204 SCALE: 1/8" = 1'-0"

POWER NOTES PART D

1. INSTALL RELOCATED FROM SCIENCE LAB 108, CORD REEL DROPS, HARD WIRE IN BOX, FLUSH TO THE CEILING, WHITE COLOR TO MATCH CEILING.
2. INSTALL DUCT SMOKE DETECTOR INSIDE FIRE DAMPER. COORDINATE EXACT LOCATION WITH MECHANICAL CONTRACTOR.
3. FURNISH AND INSTALL HORIZONTAL DUPLEX RECEPTACLE BOXES ON THE COUNTERTOP (TYP TO ALL).
4. PROVIDE CEILING MOUNT BREAK GLASS DETECTOR COMPATIBLE WITH EXISTING SECURITY SYSTEM. COORDINATE WITH SECURITY CONTRACTOR.

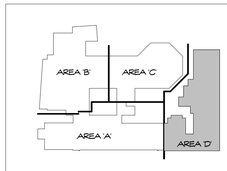
IMPORTANT NOTES:

1) CONTRACTOR SHALL COORDINATE IN FIELD EXACT LOCATION OF THE FIRE ALARM DEVICES AND ALL WALL SWITCHES WITH CASEWORKS, FURNITURE OR OTHER MECHANICAL EQUIPMENTS.

2) EACH FCU WILL BE FACTORY FURNISHED WITH A DISCONNECT SWITCH . EACH ROOM SHOULD BE PROVIDED BY MECHANICAL CONTRACTOR WITH A SELECTOR BOX SWITCH (Sss) TO SERVE THE UNITS IN THE ROOM, ABOVE THE CEILING. COORDINATE LOCATION WITH MECHANICAL DRAWINGS. THE SELECTOR BOX SHALL BE CONNECTED TO THE SAME CIRCUIT OF THE DISCONNECT SWITCHES, AHEAD OF THE DISCONNECT - TO DO THE FUTURE SERVICE TO EACH INDIVIDUAL UNIT. SO THE SWITCH WILL BE POWERED FOR OTHER FCU UNITS. (TYPICAL FOR VRV-1, VRV-2, VRV-3, VRV-4, VRV-7, VRV-8 AND VRV-9).

3) $=2 - motor rated disconnect switch for MCA: 2.8 to 3.4Amps
$=3 - motor rated disconnect switch for MCA: 2.3 to 2.8Amps
$=4 - motor rated disconnect switch for MCA: 1.4 to 1.8Amps
$=5 - motor rated disconnect switch for MCA: 51.0Amps

4) PROVIDE ALL FIRE ALARM PULL STATIONS WITH COVERS.



NORTH
KEY PLAN
FIRST FLOOR

Project Title:
Expansion and Alterations to:
WEST SHORE MIDDLE SCHOOL
70 Kay Avenue, Milford CT 06460

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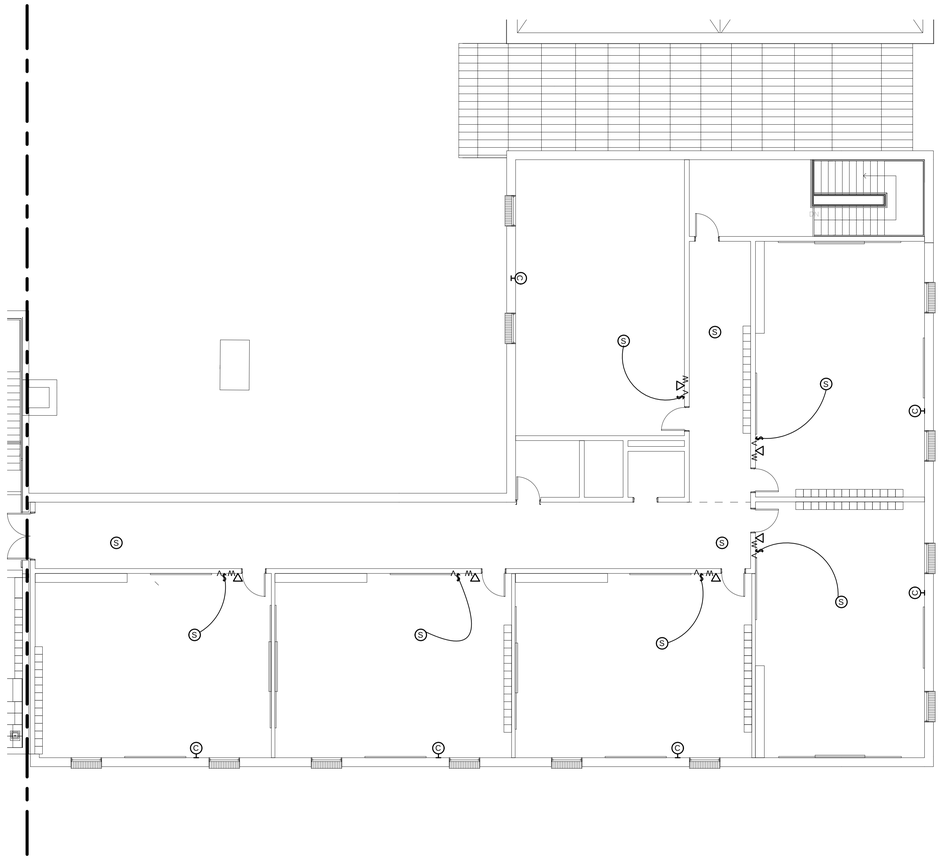
Drawing Title:
POWER PLAN PART D

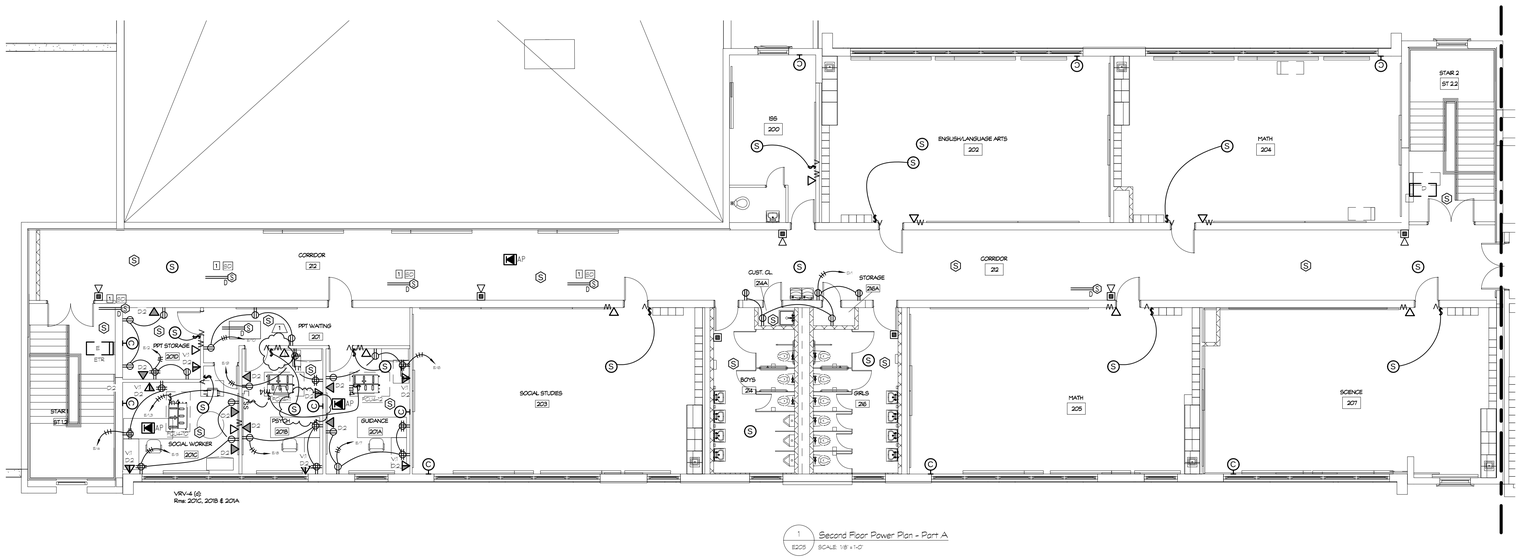
State Project Number: TMP-084-JLGB

Date: 8/18/2016
Scale: 1/8" = 1'-0"
Drawn By: MSanza - Elect. Engineer
Project Number: 14.278

Drawing Number:
E204



3 Second Floor Power Plan - Part B
E205 SCALE: 1/8" = 1'-0"



1 Second Floor Power Plan - Part A
E205 SCALE: 1/8" = 1'-0"

POWER NOTES UPPER LEVEL PART A

1 INSTALL DUCT SMOKE DETECTOR INSIDE FIRE DAMPER. COORDINATE EXACT LOCATION WITH MECHANICAL CONTRACTOR

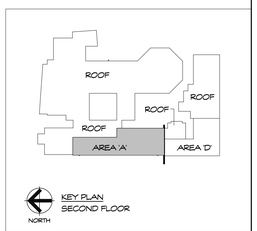
IMPORTANT NOTES:

1) CONTRACTOR SHALL COORDINATE IN FIELD EXACT LOCATON OF THE FIRE ALARM DEVICES AND ALL WALL SWITCHES WITH CASEWORKS, FURNITURE OR OTHER MECHANICAL EQUIPMENTS.

2) EACH FCU WILL BE FACTORY FURNISHED WITH A DISCONNECT SWITCH . EACH ROOM SHOULD BE PROVIDED BY MECHANICAL CONTRACTOR WITH A SELECTOR BOX SWITCH (Box) TO SERVE THE UNITS IN THE ROOM, ABOVE THE CEILING. COORDINATE LOCATION WITH MECHANICAL DRAWINGS. THE SELECTOR BOX SHALL BE CONNECTED TO THE SAME CIRCUIT OF THE DISCONNECT SWITCHES, AHEAD OF THE DISCONNECT - TO DO THE FUTURE SERVICE TO EACH NON DUAL UNIT, SO THE SWITCH WILL BE POWERED FOR OTHER FCU UNITS. (TYPICAL FOR VRV-1, VRV-2, VRV-3, VRV-4 and VRV-7).

3) $m2 - motor rated disconnect switch for MCA 2.8 to 3.4Amps
$m3 - motor rated disconnect switch for MCA 0.3 to 0.8Amps
$m4 - motor rated disconnect switch for MCA 1.4 to 1.8Amps
$m5 - motor rated disconnect switch for MCA 9.2Amps

4) PROVIDE ALL FIRE ALARM PULL STATIONS WITH COVERS.



KEY PLAN
SECOND FLOOR

Project Title:
Expansion and Alterations to:
WEST SHORE MIDDLE SCHOOL
70 Kay Avenue, Milford CT 06460

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Drawing Title:
POWER UPPER LEVEL PLAN
PART A

State Project Number: TMP-084-JLGB

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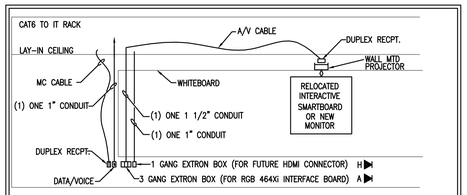
Scale: 1/8" = 1'-0"
Drawn By: M.Barrios - Electr. Engineer
Project Number: 14.278

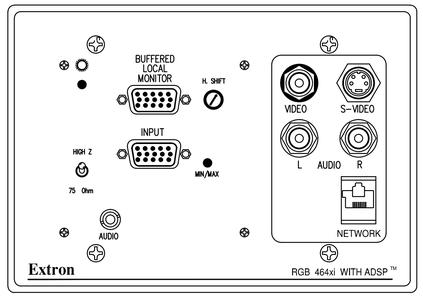
Drawing Number:
E205



INTERACTIVE SMART BOARD DETAIL

SCALE: 1/4" = 1'-0"

1. PROVIDE CONDUIT FROM PROJECTOR TO TEACHERS OUTLET ON WALL. A FOR RELOCATED SMARTBOARD LOCATIONS. SERVICES SHALL RUN TO WALL BEHIND NEW SMART MONITORS IN ROOMS 187, 100, 133 & 160.



RGB 464XI ANALOG INTERFACE PLATE

NTS

NOTE: THE ELECTRICAL CONTRACTOR SHALL FURNISH AND INSTALL EXTRON 'RGB 464XI' PLATE OR EQUAL.

NOTE: 'RGB 464XI' EXTRON ANALOG PLATE CONNECTORS:

A PROVIDE WIRES AND CONDUIT FROM THE BACK SIDE OF RGB 464XI WALL PLATE IN EXTRON STANDARD THREE (3) GANG BOXES OUTLETS (4.55" H X 6.45" W X 2.50" D) TO CEILING SPEAKERS AND FUTURE SMART BOARD PROJECTOR. PROVIDE IN 1 1/2" CONDUIT SPEAKERS AND PROJECTOR WIRES FROM RGB INTERFACE TO ABOVE HUNG CEILING.

PROVIDE CAPTIVE SPEAKER CABLES INSIDE ABOVE 1 1/2" CONDUIT, FROM THE BACK OF RGB INTERFACE, AUDIO CONNECTOR TO CEILING SPEAKERS. INSET WIRES INTO AND TIGHTEN THE SCREWS ON 3.5MM, 5-POLE, DIRECT INSERTION AUDIO OUTPUT. THE OTHER END CONNECT TRS CONNECTORS, STANDARD 3.5MM.

THE VGA RGB 464XI MUST BE FACTORY PROVIDED WITH 24VDC HARD WIRED POWER SUPPLY, FOR THE INTERFACE BOARD. HARD WIRER TO J-BOX ABOVE HUNG CEILING AND CONNECT TO ROOM RECEPTACLE CIRCUIT.

PROVIDE ONE (1) VGA CABLE TYPE RGBHV PLENUM-RATED FROM VGA CONNECTOR (5 WIRES TERMINALS) (ON THE BACK SIDE OF INTERFACE) TO PROJECTOR. PROVIDE AN ADAPTER ON THE OTHER END RGBHV TO VGA TO CONNECT TO THE PROJECTOR. USE SAME CONDUIT 1 1/2" .

H PROVIDE ADDITIONAL 1 GANG BOX, CLOSE TO RGB WALL PLATE FOR DIGITAL HDMI CONNECTOR. USE 'LEVITON 41647 W DECORA HDMI WALLPLATE' WHITE, FEMALE TO FEMALE CONNECTOR OR EQUAL. PROVIDE 'IN-WALL RATED HDMI CABLE' (ENDED MALE-MALE HDMI CONNECTORS) FROM HDMI CONNECTOR TO FUTURE SMART BOARD PROJECTOR LOCATION, IN 1" CONDUIT.

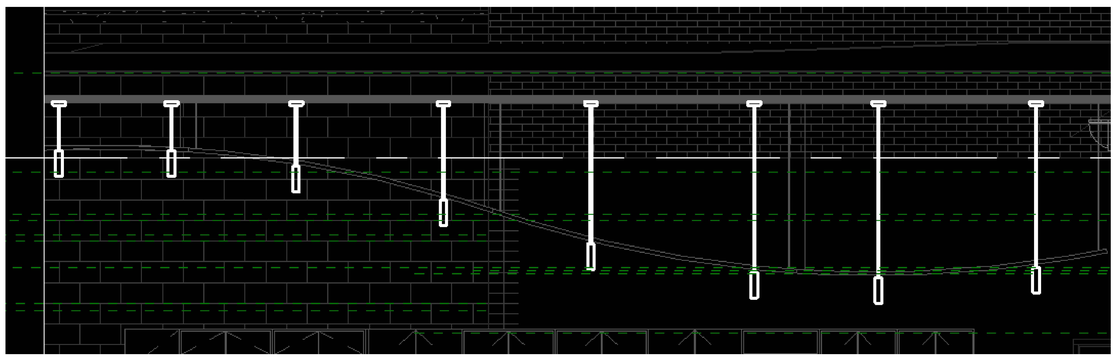
COORDINATE LOCATION IN FIELD WITH SMART BOARDS AND RGB INTERFACE LOCATIONS FOR THE LENGTH OF THE CABLES.

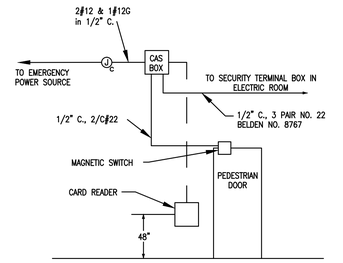
CATV SYSTEM:

IV CATV

CONTRACTOR SHALL PROVIDE 4" J-BOX WITH JACKS AND 3/4"C TO ACCESSIBLE CEILING SPACE AT EACH DROP LOCATION. PROVIDE COAX CABLE RG6 WITH CONNECTORS AT EACH END. ALL HOMERUNS SHALL GO TO CENTRAL LOCATION. COORDINATE WITH OWNER FOR EXACT LOCATION.

PANDANT IN ART RM 102 RM 104 EXAMPLE





DETAIL INTERIOR CAS READER INSTALLATION

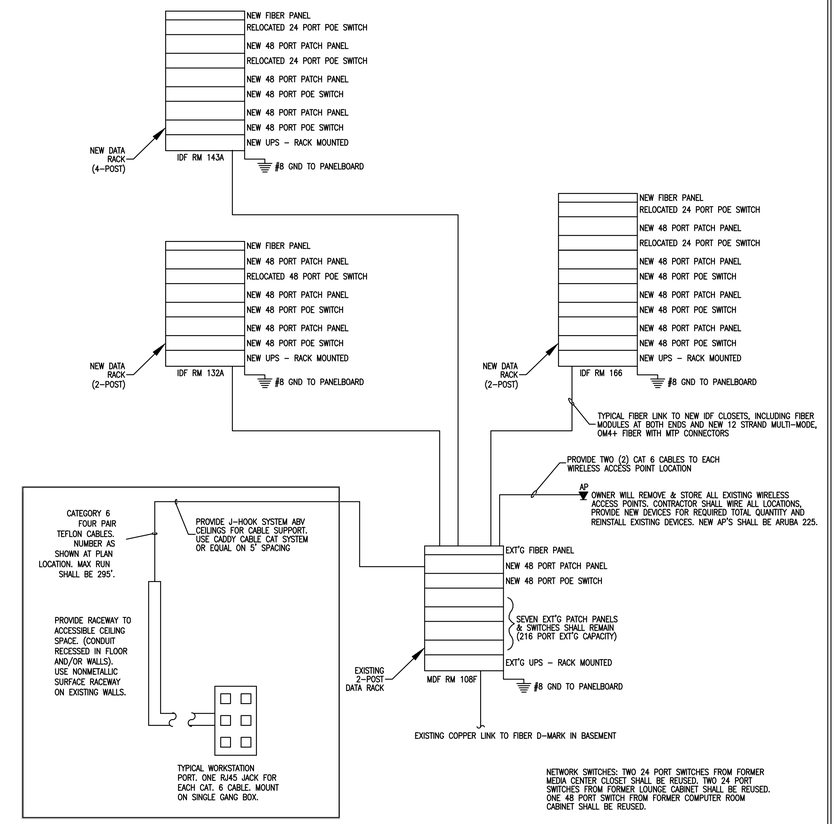
NTS

CARD READER AND DOORS STRIKE

CONTRACTOR SHALL PROVIDE 120V/1P/20A, JUNCTION BOX, 3/4" CONDUIT AND WIRES FROM CIRCUITING IN THE AREA, TO ABOVE SUSPENDED CEILING (CARD READER AND WIRING BY OTHERS), ADJACENT TO EACH DOOR WHICH NEEDS TO HAVE CARD READER AND DOOR STRIKE. PROVIDE 3/4" CONDUIT FROM ELECTRICAL DOOR HINGE LOCATION (PAIR DOORS) OR ELECTRICAL STRIKE LOCATION (SINGLE DOOR) TO JUNCTION BOX ABOVE CEILING. COORDINATE LOCATION AND HEIGHT WITH IT MANAGER AND ARCHITECTURAL DRAWINGS COMPONENTS SHALL BE WIRED TO BUILDING CONTROL ACCESS SYSTEM BOX. COORDINATE WITH TECHNOLOGY AND SECURITY MANAGER CONTRACTOR.

1

EMERGENCY IDENTIFICATION: CONTRACTOR SHALL IDENTIFY ALL CIRCUIT BREAKERS SERVING EMERGENCY LIGHTING AND EXIT SIGN LOADS. THIS IDENTIFICATION SHALL BE PROVIDED FOR ALL NEW AND EXISTING PANELBOARDS. PERFORM SURVEY OF EXISTING PANELBOARD CIRCUITS AS NECESSARY. BREAKERS FOR THESE LOADS SHALL BE PHYSICALLY GROUPED WITHIN THE PANELS TO THE EXTENT FEASIBLE.



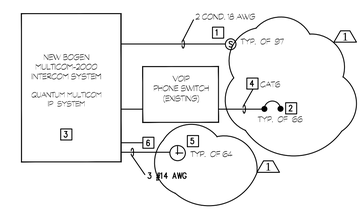
COMPUTER NETWORK SCHEMATIC

SCALE: NONE

1

ALLOW FOR FIVE (5) ADDITIONAL BOGEN HANDSETS, FIVE (5) ADDITIONAL BOGEN CLOCKS AND FIVE (5) ADDITIONAL BOGEN SPEAKERS, INSTALLED WITH 50' OF PA CABLE.

ADDED DEVICES SHALL BE CARRIED IN BASE BID. PRICE FOR PA SYSTEM.



COMMUNICATION SYSTEM SCHEMATIC

SCALE: NONE

1

1. PROVIDE NEW CEILING GRILL, TILE BRIDGE & BACKBOX FOR CEILING INSTALLATION. REWORK OR REPLACE EXISTING WIRING, PROVIDE NEW HOMERUN FOR NEW LOCATION.
2. PHONE MOUNTED ON SINGLE-GANG BOX AT 48" AFF FOR GENERAL LOCATIONS, 18" AFF FOR DESK LOCATIONS.
3. TERMINATIONS AND PROGRAMMING WITHIN THE BOGEN MULTICOM-2000 INTERCOM SYSTEM PANELS SHALL BE PERFORMED BY AN AUTHORIZED & CERTIFIED REPRESENTATIVE OF BOGEN. A CERTIFICATE MUST BE PROVIDED.
4. HOMERUN ALL WIRING TO IT CLOSET SERVING THE RESPECTIVE AREA. VERIFY WITH OWNER IN FIELD.
5. PROVIDE NEW BOGEN 'BCMA SERIES WIRELESS MASTER CLOCK', HOMERUN ALL WIRING TO PANEL IN NEW MAIN OFFICE AT NEW LOCATION. VERIFY WITH OWNER IN FIELD.
6. PROVIDE CONNECTION FROM NEW INTERCOM SYSTEM TO EXISTING S2 SECURITY SYSTEM FOR ANNUNCIATION OF LOCKDOWN MESSAGES.
7. REFER TO SPECIFICATION DIV. 27 FOR DETAILS ON DEVICES. ALL DEVICES ARE NEW UNLESS NOTED OTHERWISE.
8. PROVIDE BCMA 1000 SERIES WIRELESS REPEATER FOR EXTENDING THE BOGEN WIRELESS SIGNAL WHEN LONGER DISTANCES BETWEEN CLOCKS ARE PRESENT, IF NEED IT.
9. A DEDICATED #10 GROUND WIRE SHALL BE INSTALLED IN CONDUIT FROM THE MAIN GROUND BUS OF THE ELECTRICAL SERVICE AND/OR ADEQUATE BUILDING GROUND AND ATTACHED TO THE FRAME OF ALL THE SOUND RACKS/CABINETS AND ALL REQURED DEVICES. CONDUIT BONDS SHALL BE USED ONLY FOR RACK TO RACK CONTINUITIES. REFER TO SPECIFICATION 275116 - PUBLIC ADDRESS SYSTEM.