STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION

2800 BERLIN TURNPIKE, P.O. BOX 317546
NEWINGTON, CONNECTICUT 06131-7546
Phone:
(860) 594-3129

Subject: Project No. 300-139
New Haven: Independent Wheel True
Facility – New Haven Rail Yard.

March 8, 2011

NOTICE TO CONTRACTORS:

This is to notify all concerned and especially the prospective bidders that the bid opening for the subject project is still scheduled for March 23, 2011 at 2:00 P.M. in the Conference Room of the Department of Transportation Administration Building, 2800 Berlin Turnpike, Newington, Connecticut.

Addendum No. 1 is attached

This addendum is necessary to add, revise and delete Special Provisions, Contract Items, Plan Sheets and to add permits.

Revised Bid Proposal Forms are being issued to prospective bidders.

Gregory D. Straka
Contracts Manager
Division of Contracts Administration

MARCH 8, 2011

NEW HAVEN RAIL YARD FACILITIES IMPROVEMENTS:

INDEPENDENT WHEEL TRUING FACILITY

STATE PROJECT NO. 300-139
CITY OF NEW HAVEN

ADDENDUM NO. 1

SPECIAL PROVISIONS
NEW SPECIAL PROVISIONS
The following Special Provisions are hereby added to the Contract:

- NOTICE TO CONTRACTOR – SUBMITTALS
- NOTICE TO CONTRACTOR – USE OF STATE PROPERTY
- NOTICE TO CONTRACTOR – ACCEPTANCE OF OWNER-FURNISHED TRACK MATERIAL
- NOTICE TO CONTRACTOR- METRO-NORTH RAILROAD RECOMMENDED PRACTICE FOR CONSTRUCTION OF TRACK DOCUMENTS
- ***ITEM NO. 0205004A – ROCK IN TRENCH EXCAVATION 0’ – 10’ DEEP
- ***ITEM NO. 0205006A – ROCK IN TRENCH EXCAVATION 0’ – 15’ DEEP
- ITEM NO. 0216012A – CONTROLLED LOW STRENGTH MATERIAL
- ITEM NO. 0507237A – SPECIAL ROUND TYPE “C-L” CATCH BASIN OVER 10’ DEEP
- ITEM NO. 0507238A – SPECIAL ROUND TYPE “C-L” CATCH BASIN
- ITEM NO. 0821206A – PRECAST CONCRETE BARRIER CURB (24” X 32”)
- ***ITEM NO. 1301080A – 4” DUCTILE IRON PIPE (WATER PIPE)
- ***ITEM NO. 1302002A – 4” GATE VALVE

*** **Item No. is being added to an “existing” multi-item specification**

REVISED SPECIAL PROVISIONS

The following Special Provisions are hereby deleted in their entirety and replaced with the attached like-named Special Provisions:

- NOTICE TO CONTRACTOR – CONTRACT TIME AND LIQUIDATED DAMAGES
- NOTICE TO CONTRACTOR – PROJECT COORDINATION
- NOTICE TO CONTRACTOR – PROJECT PHASING REQUIREMENTS
- NOTICE TO CONTRACTOR – METRO-NORTH RAILROAD SUBMITTALS
- NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS
- SECTION 1.05 – CONTROL OF THE WORK
- ITEM NO. 0000349A – 4" PVC DUCT BANKS – 8 DUCTS
- ITEM NO. 0000354A – 4" PVC DUCT BANKS – 12 DUCTS
- ITEM NO. 0000426A – ELECTRIC HANDHOLE
- ITEM NO. 0000545A – 5" PVC DUCT BANKS – 2 DUCTS
- ITEM NO. 0000546A – 5" PVC DUCT BANKS – 4 DUCTS
- ITEM NO. 0000547A – 5" PVC DUCT BANKS – 6 DUCTS
- ITEM NO. 0000580A – 4" PVC DUCT BANKS – 1 DUCTS
- ITEM NO. 0000581A – 4" PVC DUCT BANKS – 2 DUCTS
- ITEM NO. 0000582A – 4" PVC DUCT BANKS – 4 DUCTS
- ITEM NO. 0000591A – 3" PVC DUCT BANKS – 2 DUCTS
- ITEM NO. 0001130A – 500 KCMIL, 15 KV SHIELDED COPPER CABLE
- ITEM NO. 0202003A – EARTH EXCAVATION
- ITEM NO. 0203003A – STRUCTURE EXCAVATION – EARTH (COMPLETE)
- ITEM NO. 0205003A – TRENCH EXCAVATION 0' – 10' DEEP
- ITEM NO. 0205005A – TRENCH EXCAVATION 0' – 15' DEEP
- ITEM NO. 0504010A – RAILROAD TRACK WORK
- ITEM NO. 0503004A – LIFT AND LINE EXISTING TRACK
- ITEM NO. 0503471A – TURNOUT INSTALLATION
- ITEM NO. 0507162A – TYPE "C-L" CATCH BASIN, DOUBLE GRATE TYPE II WITH 4' SUMP OVER 10' DEEP
- ITEM NO. 0507484A – TYPE "C-L" CATCH BASIN, DOUBLE GRATE TYPE II (4' SUMP)
- ITEM NO. 0507685A –MANHOLE – 6' DIAMETER
- ITEM NO. 0603169A – PROGRESS PHOTOGRAPHS
- ITEM NO. 0651380A – 36" POLYVINYL CHLORIDE PIPE
- ITEM NO. 0651743A – 6" POLYVINYL CHLORIDE PIPE
- ITEM NO. 0651746A - 12" POLYVINYL CHLORIDE PIPE
- ITEM NO. 0651757A - 18" POLYVINYL CHLORIDE PIPE
- ITEM NO. 0651761A - 24" POLYVINYL CHLORIDE PIPE

- ITEM NO. 0651762A - 30” P. V. C. PIPE
- ITEM NO. 0702396A – DRIVING PRESTRESSED CONCRETE PILES
- ITEM NO. 0702801A – PILE LOADING TEST
- ITEM NO. 0969050A – DOCUMENT CONTROL SPECIALIST
- ITEM NO. 0980101A – CONSTRUCTION STAKING (SITE NO. 1)
- ITEM NO. 1010912A – ELECTRIC MANHOLE
- ITEM NO. 1010916A – CONCRETE MANHOLE
- ITEM NO. 1020005A – WOOD POLE (45 FEET)
- ITEM NO. 1108798A – CENTRAL COMMUNICATION EQUIPMENT
- ITEM NO. 1301081A – 6” DUCTILE IRON PIPE (WATER MAIN)
- ITEM NO. 1301082A – 8” DUCTILE IRON PIPE (WATER MAIN)
- ITEM NO. 1301084A – 12” DUCTILE IRON PIPE (WATER MAIN)
- ITEM NO. 1400101A – 6” POLYVINYL CHLORIDE PIPE (SANITARY SEWER)
- ITEM NO. 1400102A - 8” POLYVINYL CHLORIDE PIPE (SANITARY SEWER)
- ITEM NO. 1400103A - 10” POLYVINYL CHLORIDE PIPE (SANITARY SEWER)
- ITEM NO. 1403001A – MANHOLE (SANITARY SEWER)
- ITEM NO. 1500006A – UTILITY ADJUSTMENT (ESTIMATED COST PLUS)

DELETED SPECIAL PROVISIONS

The following Special Provisions are hereby deleted in their entirety:

- ITEM NO. 0216003A – PERVIOUS STRUCTURE BACKFILL
- ITEM NO. 0652101A - PLUG PIPE
- ITEM NO. 0980001A – CONSTRUCTION STAKING
- ***** ITEM NO. 1302003A – 6” GATE VALVE
- ITEM NO. 1700001A – SERVICE CONNECTIONS (ESTIMATED COST)

***This Item No. is being deleted from an existing “multi-item” specification**

NEW CSI SPECIAL PROVISION

The following CSI Special Provision is hereby added to the Contract:

- SECTION 07 14 00 – FLUID APPLIED WATERPROOFING

REVISED CSI SPECIAL PROVISIONS

The following CSI Special Provisions are hereby deleted in their entirety and replaced with the attached like-named Special Provisions:

- SECTION 03 30 00 – CAST-IN-PLACE CONCRETE
- SECTION 05 10 00 – STRUCTURAL METAL FRAMING
- SECTION 07 54 00 – THERMOPLASTIC MEMBRANE ROOFING
- SECTION 21 13 13 – WET-PIPE SPRINKLER SYSTEMS
- SECTION 21 13 16 – DRY-PIPE SPRINKLER SYSTEMS
- SECTION 22 13 19 – SANITARY WASTE PIPING SPECIALTIES
- SECTION 22 14 13 – FACILITY STORM DRAINAGE PIPING
- SECTION 22 14 23 – STORM DRAINAGE PIPING SPECIALTIES
- SECTION 22 15 13 – GENERAL-SERVICE COMPRESSED AIR PIPING
- SECTION 23 11 23 – FACILITY NATURAL GAS PIPING
- SECTION 23 72 00 – AIR –TO-AIR ENERGY RECOVERY EQUIPMENT
- SECTION 26 12 00 – MEDIUM-VOLTAGE TRANSFORMERS

DUPLICATE SPECIAL PROVISIONS

Duplicate Special Provisions and Permits were included in the contract. The following duplicated "pages" are hereby deleted in their entirety from the contract:

Page 323 thru 332 (10 pages)
Page 483 thru 508 (26 pages)
Page 614 thru 616 (3 pages)
Page 694 thru 695 (1 page)
Page 1856 thru 1871 (16 pages)
Page 2381 thru 2769 (389 pages - Permits)

PERMITS

The attached permits are hereby added to the Contract:

- Connecticut Coastal Management
- Inland Water Resources Permit

CONTRACT ITEMS

NEW CONTRACT ITEMS

ITEM NO.	DESCRIPTION	UNIT	QUANTITY
0205004A	ROCK IN TRENCH EXCAVATION 0' – 10' DEEP	CY	1,500
0205006A	ROCK IN TRENCH EXCAVATION 0' – 15' DEEP	CY	110
0216012A	CONTROLLED LOW STRENGTH MATERIAL	CY	50
0507237A	SPECIAL ROUND TYPE "C-L" CATCH BASIN OVER 10' DEEP	EA	7
0507238A	SPECIAL ROUND TYPE "C-L" CATCH BASIN	EA	3
0821206A	PRECAST CONCRETE BARRIER CURB (24" X 32")	LF	1,000
1301080A	4" DUCTILE IRON PIPE (WATER MAIN)	LF	20
1302002A	4" GATE VALVE	EA	1

REVISED CONTRACT ITEMS

ITEM NO.	DESCRIPTION	ORIGINAL QUANTITY	REVISED QUANTITY
0101117A	CONTROLLED MATERIAL HANDLING	16,000 CY	19,400 CY
0101133A	DISPOSAL OF CONTAMINATED RAILROAD TIES	35 TONS	55 TONS
0202318A	MANAGEMENT OF REUSABLE CONTROLLED MATERIAL	1,400 CY	1,800 CY
0205005A	TRENCH EXCAVATION 0' – 15' DEEP	2,000 CY	2,200 CY
0214022	COMPACTED GRANULAR FILL	2,600 CY	2,700 CY
0304002	PROCESSED AGGREGATE BASE	2,600 CY	3,100 CY
0503004A	LIFT AND LINE EXISTING TRACK	500 LF	1,000 LF
0507162A	TYPE "C-L" CATCH BASIN, DOUBLE GRATE TYPE II WITH 4' SUMP OVER 10' DEEP	10 EA	3 EA
0507484A	TYPE "C-L" CATCH BASIN, DOUBLE GRATE TYPE II (4' SUMP)	12 EA	9 EA

0507685A	MANHOLE – 6’ DIAMETER	6 EA	7 EA
0507781A	RESET MANHOLE	38 EA	37 EA
0651380A	36” POLYVINYL CHLORIDE PIPE	220 LF	250 LF
0651746A	12” POLYVINYL CHLORIDE PIPE	120 LF	350 LF
0651757A	18” POLYVINYL CHLORIDE PIPE	1,000 LF	850 LF
0651761A	24” POLYVINYL CHLORIDE PIPE	200 LF	90 LF
0755014	GEOTEXTILE (SEPARATION – HIGH SURVIVABILITY)	10,000 SY	11,000 SY
0822002	RELOCATED TEMPORARY PRECAST CONCRETE BARRIER CURB	1,500 LF	3,300 LF
1010916A	CONCRETE MANHOLE	5 EA	3 EA
1015012A	BARE COPPER GROUNDING CONDUCTOR (# 4/0)	2,700 LF	2,600 LF
1208928	SIGN FACE – SHEET ALUMINUM (TYPE III REFLECTIVE SHEETING)	70 SF	110 SF
1301081A	6” DUCTILE IRON PIPE (WATER MAIN)	100 LF	40 LF
1301082A	8” DUCTILE IRON PIPE (WATER MAIN)	1,500 LF	1,200 LF
1304083A	POLYETHYLENE ENCASEMENT OF PIPE (WATER MAIN)	2,950 LF	2,600 LF

DELETED CONTRACT ITEMS

ITEM NO.	DESCRIPTION	ORIGINAL QUANTITY	REVISED QUANTITY
0000349A	4” PVC DUCT BANKS – 8 DUCTS	60 LF	0
0000357A	4” RGS DUCT BANK – 2 DUCTS	12 LF	0
1302003A	6” GATE VALVE	1 EA	0

PLANS

NEW PLANS

The following Plan Sheets are hereby added to the Contract:

42-1, 118-1, 250-1, 263-1 AND 402-1

REVISED PLANS

The following Plan Sheets are hereby deleted and replaced with the like-numbered Plan Sheets:

7, 10, 12, 13, 14, 15, 16, 19, 26, 27, 28, 32, 33, 35, 37, 39, 40, 43, 44, 46, 47, 50, 51, 54, 55, 56, 59, 62, 63, 64, 65, 66, 67, 68, 70, 71, 75, 76, 78, 79, 80, 82, 83, 84, 86, 89, 90, 91, 93, 94, 97, 98, 103, 104, 111, 112, 114, 117, 118, 120, 121, 122, 123, 126, 190, 194, 196, 197, 198, 199, 201, 202, 203, 205, 206, 207, 209, 210, 211, 212, 216, 218, 222, 227, 230, 233, 234, 235, 237, 238, 239, 240, 241, 242, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 255, 256, 257, 258, 259, 267, 270, 271, 275, 276, 277, 281, 283, 284, 286, 287, 289, 291, 294, 295, 298, 301, 305, 318, 321, 326, 328, 337, 338, 360, 362

DELETED PLAN

The following Plan Sheet is hereby deleted in its entirety:

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The Bid Proposal Form has been revised to reflect these changes.

There will be no change in the number of calendar days due to this Addendum.

The foregoing is hereby made a part of the contract.

JUNE 9, 2010
STATE PROJECT NO.: 0300-0139
NEW HAVEN RAIL YARD
INDEPENDENT WHEEL TRUE FACILITY
CITY OF NEW HAVEN

The State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges and Incidental Construction, Form 816, 2004, as revised by the Supplemental Specifications dated January 2010 (otherwise referred to collectively as "ConnDOT Form 816") is hereby made part of this contract, as modified by the Special Provisions contained herein. The State of Connecticut Department of Transportation's "Construction Contract Bidding and Award Manual" ("Manual"), August 21, 2000 edition or latest issue, is hereby made part of this contract. If the provisions of this Manual conflict with provisions of other Department documents (not including statutes or regulations) the provisions of the Manual will govern. The Manual is available upon request from the Transportation Manager of Contracts. The Special Provisions relate in particular to the New Haven Rail Yard Facilities Improvements Independent Wheel True Facility in the City of New Haven.

All work depicted in these Contract Documents is part of the overall work to be performed by the Independent Wheel True Facility Contractor, unless otherwise noted.

CONTRACT TIME AND LIQUIDATED DAMAGES

There will be three assessments for liquidated damages and they will be addressed in the following manner:

Six Hundred and Thirty Four (634) calendar days will be allowed for completion of the work on this
Project and the liquidated damages charge to apply will be **Five Thousand Nine Hundred and Fifty Dollars ($5,950.00)** per calendar day.

All construction activities related to the completion of the first phase employee parking shall be completed within **One Hundred (100)** calendar days of Notice to Proceed. The liquidated damages charge to apply to this portion of the work will be **Two Thousand Dollars ($2,000.00)** per calendar day. If completion of this work ends while bituminous mixing plants are closed for the winter, this contract time shall include all work up to and including installation of the sub-base, however, shall not include the actual paving. Once bituminous mixing plants reopen in the spring, the contractor shall immediately complete this phase of the work. If directed by the Engineer, any necessary re-grading due to the Owners use of the employee parking area prior to paving shall be paid as extra work under Item 0202998A - Roadway Maintenance.

All construction activities related to the completion of the building shell to a point where the structure is ***weather-tight*** and the wheel true machine can begin to be installed by others (the Under Floor Wheel Lathe Vendor, refer to Notice to Contractor – Project Coordination for coordination requirements) shall be completed within **Four Hundred Fifty (450)** calendar days

of Notice to Proceed. The liquidated damages charge to apply to this portion of the work will be **Seven Thousand Five Hundred Dollars ($7,500.00)** per calendar day.

NOTICE TO CONTRACTOR - PROJECT COORDINATION

1.01 DESCRIPTION

A. This Section identifies project coordination requirements relative to performance of the Work.

B. The Contractor shall coordinate construction activities with the Vendor engaged to engineer, design, fabricate, deliver, install and commission an Under Floor Wheel Lathe (UFWL) and ancillary support systems in the Independent Wheel True Facility (IWT). The Contractor shall coordinate its activities with the work of Others in such a way as to minimize conflicts and interferences, and shall cooperate fully with Metro-North, Connecticut DOT (CTDOT) and its agents, and the UFWL Vendor.

C. Except as specifically allowed by the Contract, Metro-North operations, including yard operations of trains, track systems, power distribution, communications and other systems, will remain active without interruption for the duration of this Contract.

1.02 PROJECT SCHEDULE

A. The Contractor shall include in its Project Schedule activities in support of a three (3) month activity when the UFWL Vendor will install and commission the UFWL machine and ancillary systems within the pit of the IWT. This activity must commence as soon as the IWT facility construction has advanced to a condition of "weather-tight.", at which time the Contractor shall permit the UFWL Vendor to commence installation activities in accordance with the requirements of "NOTICE TO CONTRACTOR – ENGINEER OCCUPANCY". "Weather-tight" is defined as having the foundation, floor slab, wheel true pit, inspection pit, structural steel, roof, walls, doors and windows installed for the Main Shop Area (from Column Line 12 to the east to Column Line 7 to the west, and from Column Line B to the north to Column Line E to the south). Furthermore, all building work activities in the Main Shop Area shall be substantially complete except for final testing and commissioning, including but not limited to the following:

1. Full access by the UFWL Vendor to the Main Shop Area for transportation and rigging of machinery.
2. In-slab shop rails shall be installed, aligned to UFWL Vendor requirements, secured and cut to length in front and behind pit so that final gap filler pieces of shop rails can be custom fit in by MNR after installation of machinery. Typically, this is 3' to 6' each rail.
3. Building power, lighting and HVAC systems in the Main Shop Area shall be installed and operational.
4. Main power supply cable for machinery shall be installed.
5. Sump pumps inside the pits shall be installed and operational.
6. Any penetrations through building walls for chip disposal systems etc. shall be

complete and ready for UFWL system installation.

7. Provide temporary secure storage area or room for "valuable" items shipped with machine (printers, PC, tools, spare parts, etc).
8. Main Shop Area shall be clear of any debris.
9. Overhead crane shall be installed, tested and ready for operation.
10. Shop floor coatings shall NOT be installed until after completion of work by the UFWL Vendor.

B. The Contractor shall structure its project CPM schedule to clearly identify the activities needed to achieve the "weather-tight" milestone and to identify the UFWL Vendor activities, in accordance with the CPM schedule requirements of Item # 0969000A – Project Coordinator.

1.03 PROJECT ADMINISTRATION

A. The activities of the UFWL Vendor will be directed by the Engineer.

1.04 COOPERATION AND COORDINATION OF WORK

A. The work in this Section requires coordination with the work being performed by the UFWL Vendor that may have equipment and articles that may occupy areas in, around or adjacent to this Contract Work Site. Work shall be performed in cooperation with Other Contractors and so scheduled as to allow speedy and efficient completion of the work.

B. The UFWL Vendor shall attend coordination meetings as required by Metro-North, CTDOT and with the Contractor to coordinate the work being performed under this contract with the work being performed under contracts and agreements.

C. The Contractor shall provide Metro-North and CTDOT and the UFWL Vendor proper and safe access to the Site on a scheduled and orderly basis, and will afford them a reasonable opportunity for the delivery and storage of materials and equipment and the execution of their work. The Contractor shall not clutter the Site with equipment, materials and products which could interfere with the work of the UFWL Vendor. The Contractor shall protect the products, equipment and materials stored by the UFWL Vendor on the Site. Disputes arising with respect to delivery or storage of materials or equipment, or otherwise relating to coordination of the Work with the work of the UFWL Vendor or arising with respect to loss, damage or expense incurred or suffered by the Contractor as a result of the acts or omissions of the UFWL Vendor shall be resolved among the various Contractors without recourse to or against Metro-North or CTDOT.

D. The Contractor shall cooperate and coordinate with the UFWL Vendor in scheduling and performing the work each is required to perform under its respective contract and to furnish to the UFWL Vendor, upon request, copies of relevant portions of the Contractor's Work Plan Schedules. If the UFWL Vendor encounters a delay that can be avoided by the Contractor's rescheduling the order of the Work without adversely affecting the Contractor's

ability to complete its performance by the completion dates specified herein or its overall costs of performance of the Work, the Contractor shall reschedule its performance to accommodate the delayed UFWL Vendor.

E. The Contractor shall cooperate and coordinate with the UFWL Vendor with respect to all aspects of its performance of the Work which affects the performance of the UFWL Vendor. With respect to facilities which are to be shared by the UFWL Vendor, the Contractor shall mutually agree with the UFWL Vendor on lay down and storage space and the Contractor shall store and access its equipment and materials in a manner that will permit the UFWL Vendor to have sufficient access to their respective equipment and materials. The Contractor shall coordinate with the UFWL Vendor with respect to delivery schedules in order to avoid impeding the access to their respective equipment and materials. The Contractor shall cooperate with the UFWL Vendor in adequately securing common gates and access ways, and establishing agreed upon procedures to protect the security of the equipment and materials of the UFWL Vendor.

F. With respect to access to the Site, the Contractor shall cooperate with the UFWL Vendor so that the moving of equipment, materials and work forces onto the Site through any limited access point shall occur in the most expeditious manner. The Contractor shall not obstruct any common access point without good reason and reasonable prior notice to the UFWL Vendor and reasonable attempts at accommodating the UFWL Vendor with alternative access, if such obstruction shall continue for more than a brief time.

G. Contractor shall assure that its forces coordinate and cooperate with the forces of the UFWL Vendor working on the Project.

H. The Contractor shall install two benchmarks within the Wheel True Pit for use by the UFWL Vendor in the installation of the UFWL and ancillary systems. The locations of the benchmarks shall be coordinated in advance with the UFWL Vendor to ensure that the benchmarks are in convenient and accessible locations.

I. The Contractor shall utilize shop drawings of the UFWL Vendor indicating the location and nature of foundation elements for the UFWL machinery in the layout of the Wheel True pit slab.

J. Mutual Responsibility

1. The Contractor shall afford the UFWL Vendor reasonable opportunity for introduction and storage of their materials and equipment and performance of their activities and shall connect and coordinate the Contractor's construction and operations with theirs as required by the Contract Documents.

2. If part of the Work depends upon proper execution or results upon construction or operations by the UFWL Vendor, the Contractor shall, prior to proceeding with that portion of the Work, promptly report to CTDOT apparent discrepancies or defects in

such other construction that would render it unsuitable for such proper execution and results. Failure of the Contractor so to report shall constitute an acknowledgment that the UFWL Vendor completed or partially completed construction is fit and proper to receive the Work, except as to defects not then reasonably discoverable.

3. Whenever the Work is dependent upon the work of the UFWL Vendor, the Contractor shall:

   a. Coordinate its dependent Work with such other work;
   b. Provide the UFWL Vendor with all necessary dependent data and requirements;
   c. Examine the drawings and specifications of the work of the UFWL Vendor;
   d. Notify the UFWL Vendor, with a copy of the notice delivered to CTDOT's Construction Project Manager, of all improperly installed work which would prevent satisfactory installation of the dependent Work; and
   e. Take all other steps as are necessary to ensure that the dependent Work is properly constructed and installed.

4. At all locations where a portion of the Project to be installed or constructed by the Contractor abuts a portion of the Project to be installed or constructed by the UFWL Vendor, the Contractor shall take special care to ensure that such installation or construction is coordinated to result in a smooth junction between the two portions of the Project, without gaps or mismatches in connections, materials, equipment or grade. If the Contractor proposes to engage in activities which by their nature are disruptive to the activities of the UFWL Vendor, the Contractor shall give reasonable prior notice to the UFWL Vendor and shall coordinate with the UFWL Vendor to schedule such activity in the least disruptive time practicable under the circumstances. When practical, the Contractor shall coordinate similar disruptive activities with the UFWL Vendor so that they occur simultaneously or in sequence if that would benefit the Project as a whole.

5. The Contractor shall promptly remedy damage wrongfully caused by the Contractor to completed or partially completed construction or to property of the UFWL Vendor.

NOTICE TO CONTRACTOR - PROJECT PHASING REQUIREMENTS

The construction of the Independent Wheel True Facility shall be phased so that all New Haven Rail Yard operations and facilities will continue as normal without interruption unless specifically detailed in the Contract documents. The Contractor is notified that the installation of road crossings on Roadways 200 and 700 must be scheduled during off peak hours to reduce the impact to railroad operations.

The Contractor is responsible for developing its own phasing plan for the Engineer's approval for the Project work. A suggested phasing plan, representing one possible sequence, is provided in the Contract Plans for the Contractor's information.

Although the Contractor is responsible for developing its own phasing plan, the Contractor shall comply with the following construction milestones:

Three Months from NTP: Install Roadways and Parking Areas West of Church Street Bridge

Contractor shall complete all subsurface utility installation and the roadways and unpaved parking areas noted in Stage 1 of the Construction Staging.

Fifteen Months from NTP: Construction of the Wheel True Facility to Weather-Tight State

Contractor shall complete shell of the building up to a state that will provide weather and environmental protection of the interior space sufficient to permit the installation of the tandem wheel true machinery.

Twenty-Two and One Half Months from NTP: Substantial Completion

Scope of Project shall be completed.

The Contractor should refer to Contract Time and Liquidated Damages for the specific number of days allowed for milestone completions.

NOTICE TO CONTRACTOR – SUBMITTALS

Transmittal of Submittals: Unless otherwise stipulated, all submittals requiring review for conformance with the Contract shall be transmitted electronically in accordance with ITEM #0969050A - DOCUMENT CONTROL SPECIALIST to PB Americas, 148 Eastern Boulevard, Suite 200, Glastonbury, CT 06033, Attention: Mr. Glen E. Hayden, P.E.

Electronic copies of all transmittal letters shall be sent to the Connecticut Department of Transportation Design and Construction representatives as well as Metro-North Railroad.

At the time the foregoing submission is made to the Designer, electronic copies of all submittals requiring Metro-North Railroad review for conformance with the Contract shall be routed directly to Metro-North Railroad. See NOTICE TO CONTRACTOR - METRO-NORTH RAILROAD SUBMITTALS for submittals requiring Metro-North Railroad approval.

At the time the foregoing submission is made to the Designer, electronic copies of all submittals requiring Commissioning Agent review for conformance with the Contract shall be routed directly to the Commissioning Agent, See NOTICE TO CONTRACTOR – COMMISSIONING RELATED SUBMITTALS for submittals requiring Commissioning Agent approval.

At the time the foregoing submission is made to the Designer, the Designer will forward electronic copies of all submittals requiring FM Global review for conformance with the Contract directly to FM Global, See NOTICE TO CONTRACTOR – FM GLOBAL SUBMITTALS for submittals requiring FM Global approval.

Submittals requiring review for conformance with the Contract that shall be electronically submitted directly to the Engineer in lieu of the Designer are listed below. Electronic copies of the transmittal letters shall be sent to the Connecticut Department of Transportation Design representatives and Metro-North Railroad.

Concrete Mix Design Certifications.
Asphalt Mix Design Certifications.
Erosion Control Plan and Materials.
Demolition Plan.
Disposal Plan
Structure erection plans including erection methods and procedures

Submittals requiring review for conformance with the Environmental Contract work that shall be electronically submitted directly to the District Engineer in lieu of the Designer are listed below. Electronic copies of the transmittal letters shall be sent to the Manager of State Design.

Health and Safety Plan.
Disposal Plan and Site.
Lead Abatement Plan.

Submittal Preparation and Processing: The Contractor shall provide the Designer with complete submittal packages (Product Data, Shop Drawings, Samples, and Quality Assurance Submittals, as applicable) for individual elements of Project work for a concurrent review of all information. Incomplete submittal packages will be returned to the Contractor without being reviewed.

Samples: Where Samples are for selection of color, pattern, texture or similar characteristics from a range of choices, submit 4 full sets of the standard and custom choices for the material or product. Where Samples illustrate assembly details, workmanship, fabrication techniques, connections, operation and similar characteristics, submit 1 sample (or set, if applicable).

Designer's Action: The Designer will return electronic copies marked with action taken and corrections or modifications required.

Samples: The Designer will return one set of samples marked with the action taken. The set of samples shall be maintained at the Project site when returned.

Maintenance Manuals and Warranties – Maintenance manuals and warranties shall be submitted both electronically and in hard copy form. Refer to "Notice to Contractors – Closeout Documents" for further requirements. Maintenance manuals and warranties will not be returned unless they are rejected.

NOTICE TO CONTRACTOR – METRO-NORTH RAILROAD SUBMITTALS

The submittals associated with the specifications listed below, that require Metro-North Railroad review for conformance with the Contract, shall be clearly labeled "Requires Metro-North Review" on the transmittal when submitted electronically. Hard copies of all final approved submittals shall be hand delivered or sent by mail directly to Metro-North Railroad, 50 Union Avenue, 2nd Floor (West), New Haven, CT 06519, Attention: Mr. Jay Patel. Review of the following submittals may take up to 60 days in accordance with Form 816 Article 1.20-1.05.02. The Contractor shall bid the project accordingly.

Special Provisions

1. ITEM #0000523A - 600 V COPPER WIRE NO. 500 KCMIL
   ITEM #0000641A - 600 V COPPER WIRE NO. 250 KCMIL
   ITEM #1012180A – BARE COPPER WIRE NO. 4/0 AWG
2. ITEM #0000591A - 3" PVC DUCT BANKS – 2 DUCTS
   ITEM #0000580A – 4" PVC DUCT BANKS – 1 DUCT
   ITEM #0000581A – 4" PVC DUCT BANKS – 2 DUCTS
   ITEM #0000582A – 4" PVC DUCT BANKS – 4 DUCTS
   ITEM #0000349A – 4" PVC DUCT BANKS – 8 DUCTS
   ITEM #0000354A – 4" PVC DUCT BANKS – 12 DUCTS
   ITEM #0000546A – 5" P.V.C. DUCT BANKS - 4 DUCTS
   ITEM #0000547A – 5" P.V.C. DUCT BANKS – 6 DUCTS
   ITEM #0000426A – ELECTRIC HANDHOLE
   ITEM #1010912A – ELECTRIC MANHOLE
   ITEM #1010916A – CONCRETE MANHOLE
3. ITEM #0001130A – 500 KCMIL, 15 KV, SHIELDED COPPER CABLE
4. ITEM #0090042A – CATENARY SYSTEMS
   ITEM #0090045A - AERIAL GROUND WIRE SYSTEMS
5. ITEM #0090050A - HIGH SPEED SECTION INSULATORS
6. ITEM #0090075A - GUY ASSEMBLIES
7. ITEM #0090076A - MODIFICATIONS & ADDITIONS TO EXISTING CATENARY SYSTEMS
8. ITEM #1003508A – HIGH MAST LIGHT POLE (100')
9. ITEM #1015012A – BARE COPPER GROUNDING CONDUCTOR (#4/0)

CSI-Formatted Specifications

10. CSI SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
11. CSI SECTION 26 13 00 - MEDIUM-VOLTAGE SWITCHGEAR
12. CSI SECTION 26 24 16 - PANELBOARDS
13. CSI SECTION 26 32 13 - ENGINE GENERATORS
14. CSI SECTION 26 33 53 - STATIC UNINTERRUPTIBLE POWER SUPPLY

15. CSI SECTION 27 11 00 - COMMUNICATIONS EQUIPMENT ROOM FITTINGS
16. CSI SECTION 27 53 20 - BLUE LIGHT CCTV SURVEILLANCE
17. CSI SECTION 27 53 30 - BLUE LIGHT SYSTEM
18. CSI SECTION 27 53 31 - BLUE LIGHT SYSTEM SIGNAL EQUIPMENT
19. CSI SECTION 28 13 00 - ACCESS CONTROL

Operation and Maintenance Manuals:

20. All Operation and Maintenance Manuals listed in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS

General: The list of special provisions (including CSI-formatted specifications) in the Table below may not be all-inclusive and does not relieve the Contractor from its responsibility to provide spare parts, operation and maintenance manuals, training, and warranties that are required under other Contract provisions.

This Table will be forwarded to Mr. Mark D. Neri, Office of Rails, for concurrence prior to the Semi-Final Inspection.

Spare Parts: The Contractor shall deliver spare parts on products listed in the Table below to the Project Site, to a location(s) determined by the Engineer.

Operation and Maintenance Manuals: Operation and Maintenance Manuals shall be formatted in accordance with Form 816 Article 1.20-1.08.14. Submit 4 copies of each manual to the Designer. The Designer, Metro-North Railroad, and Mr. Mark D. Neri, Office of Rails, will review the manuals for conformance to the Contract. The manuals will be processed in accordance with Form 816 Article 1.20-1.05.02, with 3 copies being forwarded to Mr. Mark D. Neri, Office of Rails, and one copy being sent to the Engineer. In addition, one (1) copy of each manual shall be sent to the Commissioning Authority. Refer to NOTICE TO CONTRACTOR – COMMISSIONING RELATED SUBMITTALS for directions on how to submit.

Materials and Finishes Maintenance Manual: The Contractor shall provide complete information in the materials and finishes manual on products listed in the Table below.

Equipment and Systems Maintenance Manuals: The Contractor shall provide complete information in the equipment and systems manual on products listed in the Table below.

Training: The Contractor shall provide training on products listed in the Table below. All training sessions shall be videotaped by the Contractor, with three (3) DVD copies forwarded to Mr. Mark D. Neri, Office of Rails, and one copy provided to the Engineer. The DVDs provided by the Contractor shall not be copy-protected in order to allow future copying and distribution by the Department as needed.

All training sessions on systems commissioned by the CxA required by the Contract Documents shall be coordinated and scheduled through the Commissioning Authority. Reference NOTICE TO CONTRACTOR - COMMISSIONING for a sample Training Form and Evaluation Form.

Training Instructors shall be a Manufacturer's Representative or Applications Engineer fully qualified in the operation, troubleshooting and maintenance procedures for the equipment or systems being covered. Sales Representatives or others possessing only general knowledge of the equipment or systems will not be acceptable.

The following format shall be used to schedule, perform, document and evaluate the required training sessions:

1. The Contractor shall submit a separate Training Form for each training session required by the Contract Documents to the Commissioning Authority. This form shall be submitted a minimum of fourteen (14) calendar days in advance of the proposed training session.
2. The Contractor shall complete the first section of the form including the proposed training session date, name of instructor(s), and proposed length (time) of the session(s). Also, attach an Agenda indicating the format of the training session and listing any handouts that will be provided.
3. The Commissioning Authority will then review the proposed training information with the Owner. If the submitted information is complete and the proposed dates meet the Owner's Operations Personnel schedule, the Commissioning Authority will respond to the Contractor to proceed with scheduling the subject training session.
4. During the training session, the Contractor shall have all in attendance sign in the third section of the Training Form. Attach additional pages if necessary. The Contractor shall then forward the Training Form to the Commissioning Authority.
5. After each Training Session is completed, the Cx Authority will issue an Evaluation Form to each of the Attendees. This feedback information will be provided to the Owner and Designer for review. If the session meets the objectives and intent of the Contract Documents, the Commissioning Authority will approve the training form and return to the Contractor for Project Records. If negative feedback is received, the Evaluation Forms will be reviewed with the Commissioning Team and if necessary, re-scheduling of the training may be required.

Training sessions shall cover the following items:

1. Review of Operations and Maintenance Manuals including all system drawings
2. Overview of system components
3. System operation under normal conditions
4. System operation under abnormal conditions
5. Emergency procedures
6. Troubleshooting procedures
7. Maintenance and Repair procedures
8. Questions

The Contractor is responsible for all costs associated with travel to and from the Training Facility, lodging during the training session and tuition & materials.

Training sessions for similar items where the class membership is likely to be the same may be combined with the advance approval of the Engineer.

Warranties: Submit 4 copies of written warranties, including special warranties to the Designer. The Designer and Mr. Mark D. Neri, Office of Rails, will review the warranties for conformance to the Contract. The warranties will be processed in accordance with Form 816 Article 1.20-1.05.02, with 3 copies being forwarded to Mr. Mark D. Neri, Office of Rails, and one copy being sent to the Engineer.

The Contractor shall provide special warranties on products and installations listed in the Table below.

Special Provision (including CSI-formatted Specifications)	Special Warranties	Spare Parts	Training	Operation and Maintenance Manuals
ITEM #0096108A - DISCONNECT SWITCH AND SECTIONALIZING JUMPER TAPS				X
ITEM #0100244A - SIGNS	X			
ITEM #1003508A - HIGH MAST LIGHTING POLE (100')		X		X
03 45 00 ARCHITECTURAL PRECAST CONCRETE	X			
07 10 13 BITUMINOUS DAMPPROOFING	X			
07 14 00 FLUID-APPLIED WATERPROOFING	X			
07 14 16 COLD FLUID-APPLIED WATERPROOFING	X			
07 19 00 WATER REPELLENT PENETRATING SEALER	X			
07 42 63 FABRICATED WALL PANEL SYSTEM	X			
07 54 00 THERMOPLASTIC MEMBRANE ROOFING	X			
07 60 00 FLASHING AND SHEET METAL	X			
07 61 00 SHEET METAL ROOFING	X			
07 81 00 APPLIED FIREPROOFING	X			
07 92 00 JOINT SEALANTS	X			
08 33 00 OVERHEAD ROLLING CLOSURES			X	X
08 41 13 ALUMINUM FRAMED ENTRANCES AND STOREFRONTS	X			
08 71 00 FINISH DOOR HARDWARE	X		X	X
08 81 00 GLASS AND GLAZING	X	X		
09 51 00 ACOUSTICAL CEILINGS		X		

Special Provision (including CSI-formatted Specifications)	Special Warranties	Spare Parts	Training	Operation and Maintenance Manuals
09 65 00 RESILIENT FLOORING AND BASE		X		
09 67 23 RESINOUS FLOORING	X			X
10 11 00 VISUAL DISPLAY SURFACES	X			
10 14 00 SIGNAGE	X			
11 24 00 GENERAL SHOP EQUIPMENT			X	X
12 24 13 ROLLER WINDOW SHADES		X	X	
21 12 00 FIRE SUPPRESSION STANDPIPES				X
21 13 13 WET-PIPE SPRINKLER SYSTEMS		X		X
21 13 16 DRY-PIPE SPRINKLER SYSTEMS		X		X
21 31 13 ELECTRIC-DRIVE, CENTRIFUGAL FIRE PUMPS				X
21 34 00 PRESSURE-MAINTENANCE PUMPS				X
21 39 00 CONTROLLERS FOR FIRE-PUMP DRIVERS		X	X	X
22 05 16 EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING				X
22 05 19 METERS AND GAGES FOR PLUMBING PIPING				X
22 05 23 GENERAL-DUTY VALVES FOR PLUMBING PIPING				X
22 05 53 IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT		X		
22 11 19 DOMESTIC WATER PIPING SPECIALTIES				X
22 11 23 DOMESTIC WATER PUMPS				X
22 12 19 FACILITY ABOVE GROUND WASTE-WATER STORAGE TANK			X	X
22 13 19 SANITARY WASTE PIPING SPECIALTIES			X	X
22 14 29 SUMP PUMP				X
22 15 13 GENERAL-SERVICE COMPRESSED-AIR PIPING				X
22 15 19 GENERAL SERVICE PACKAGED AIR COMPRESSORS AND RECEIVERS		X	X	X
22 33 00 INSTANTANEOUS ELECTRIC WATER	X		X	X

Special Provision (including CSI-formatted Specifications)	Special Warranties	Spare Parts	Training	Operation and Maintenance Manuals
HEATERS				
22 34 00 FUEL-FIRED DOMESTIC WATER HEATERS	X		X	X
22 40 00 PLUMBING FIXTURES	X			X
22 45 00 EMERGENCY PLUMBING FIXTURES				X
22 47 00 WATER COOLERS				X
23 05 53 IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT		X		
23 08 00 COMMISSIONING OF HVAC			X	X
23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC			X	X
23 11 23 FACILITY NATURAL-GAS PIPING			X	X
23 23 00 REFRIGERANT PIPING				X
23 34 13 AXIAL HVAC FANS				X
23 34 23 HVAC POWER VENTILATORS				X
23 34 33 AIR CURTAINS	X		X	X
23 55 33 FUEL-FIRED UNIT HEATERS	X			X
23 72 00 AIR-TO-AIR ENERGY RECOVERY EQUIPMENT	X	X	X	X
23 74 13 PACKAGED, OUTDOOR, CENTRAL-STATION AIR-HANDLING UNITS	X	X	X	X
23 81 26 SPLIT-SYSTEM AIR-CONDITIONERS	X		X	X
23 82 39 UNIT HEATERS				X
26 05 23 CONTROL-VOLTAGE ELECTRICAL POWER CABLES				X
26 05 26 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS				X
26 09 13 ELECTRICAL POWER MONITORING AND CONTROL			X	X
26 09 23 LIGHTING CONTROL DEVICES			X	X
26 12 00 MEDIUM-VOLTAGE TRANSFORMERS				X
26 13 00 MEDIUM-VOLTAGE SWITCHGEAR		X		X
26 24 13 SWITCHBOARDS	X	X	X	X
26 24 16 PANELBOARDS		X		X
26 27 13 ELECTRICITY METERING				X
26 27 26 WIRING DEVICES				X

Special Provision (including CSI-formatted Specifications)	Special Warranties	Spare Parts	Training	Operation and Maintenance Manuals
26 28 13 FUSES				X
26 28 16 ENCLOSED SWITCHES AND CIRCUIT BREAKERS		X		X
26 29 13 ENCLOSED CONTROLLERS		X	X	X
26 32 13 ENGINE GENERATORS	X	X	X	X
26 33 53 STATIC UNINTERRUPTIBLE POWER SUPPLY	X	X	X	X
26 36 00 TRANSFER SWITCHES			X	X
26 43 13 TRANSIENT-VOLTAGE SUPPRESSION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS	X			X
26 51 00 INTERIOR LIGHTING	X	X		X
26 56 00 EXTERIOR LIGHTING	X	X		X
27 13 01 DATA NETWORK		X		
27 13 02 TELEPHONE SYSTEM		X		
27 51 16 PUBLIC ADDRESS AND MASS NOTIFICATION SYSTEMS		X	X	X
27 53 20 BLUE LIGHT CCTV SURVEILLANCE	X		X	X
28 05 13 CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY				X
28 13 00 ACCESS CONTROL		X	X	X
28 16 00 INTRUSION DETECTION	X	X	X	X
28 23 00 VIDEO SURVEILLANCE	X		X	X
28 31 11 DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM		X	X	X
41 22 13 CRANES AND MONORAILS			X	X

NOTICE TO CONTRACTOR – USE OF STATE PROPERTY

Use of State property by the Contractor for purposes other than the construction activities included in this Contract requires advance approval from the Engineer.

This applies to activities including, but not limited to: Staging and storage areas, screening/crushing operations, asphalt or concrete plants, gravel/borrow pits, and other manufacturing and/or mining operations.

The bulk storage of fuels and lubricants shall not be permitted on State property.

The storage of hazardous materials, other than those associated with the Contractor's Project related operations, shall not be permitted on State property. The Contractor shall assume sole responsibility for the proper storage, handling, management, and disposal of hazardous materials. All remedial and punitive costs incurred by the Department as a result of the Contractor's failure to properly manage hazardous materials shall be borne by the Contractor.

The Contractor is cautioned that environmental testing of the site may be required at the Contractor's expense both prior to and upon completion of the use of the State property. The Contractor shall be responsible for restoring the site and removal of all contaminants which may have been deposited at the site during its use. The Contractor must conform to the Department's Best Management Practices, environmental permit conditions and other applicable State and federal regulations. The use and restoration of the site will be at no cost to the State of Connecticut. The use of the site will be for this specific DOT Project only. In addition, approval or denial of such request shall not be used as a reason for any time extensions or claim.

For Staging and Storage Areas

The Contractor must submit all requests for the temporary use of any State property in writing to the Engineer. The following minimum information shall be included with the request(s): a description of the proposed operation or use of the site; a site plan detailing the location of the proposed operation/use, and sedimentation and erosion controls; an area plan detailing ingress and egress to the site and proximity to residential and/or occupied buildings; copies of any required environmental permits; and planned hours of operation. The submittal shall also include photo documentation (minimum of 12 each, 8"x10" color photos) showing the preconstruction condition of the site and adjacent property at the site boundaries. If the site is State property outside of the DOT right of way, authorization from other State Agencies will also be required for use of the property or site.

For Use Other than Construction Staging and Storage Areas

The Contractor must submit all requests for the temporary use of any State property in writing to the Engineer. The request(s) shall include the same information required for storage and staging areas. In addition, the Contractor will be required to provide written confirmation that the municipality in which the site is located does not object to the proposed use of the State property. The Contractor will be required to execute a license agreement with the Department for use of State property for other than staging and storage areas.

For asphalt batching or continuous mix facilities, the Contractor shall also provide a map detailing the outer most perimeter of the facility showing all structures, land use, watercourses, wetlands, and areas of environmental concern with one-third mile of the facility perimeter. No such facility will be permitted on State property where any hospital, nursing home, school, area of critical environmental concern, watercourses, or residential housing exists within one-third mile of the perimeter of the facility (P.A. 98-216).

NOTICE TO CONTRACTOR – ACCEPTANCE OF OWNER-FURNISHED TRACK MATERIAL

As documented in the Notice to Contractor – Metro-North Railroad Force Account Work and Coordination, certain track materials will be purchased by Metro-North and made available to the Contractor. This Notice outlines the delivery and acceptance criteria for this material.

The 136 RE Rail will be delivered by Metro-North in 80' segments with bolt holes drilled in one end only. The rail will be delivered from a storage location outside of the New Haven Rail Yard following a minimum of two weeks' notice from the Contractor to the Engineer.

Two new turnouts will be delivered by Metro-North packaged in "kit" form prior to Notice to Proceed. The turnouts will be stored at a location within the New Haven Rail Yard. The Contractor shall retrieve the turnouts from this location and assemble them within the Project work limits.

NOTICE TO CONTRACTOR - METRO-NORTH RAILROAD RECOMMENDED PRACTICE FOR CONSTRUCTION OF TRACK DOCUMENTS

The track installation to be performed by the Contractor is to be performed using the standards contained in the document entitled "Metro-North Recommended Practice for Construction of Track". This is commonly referred to as the "MW-4".

Due to the sensitive nature of the information contained in this document, all respective bidders will be required to sign the Confidentiality Agreement attached to this notice prior to receiving a copy of the MW-4.

The MW-4 will be made available at the Connecticut Department of Transportation's Office of Contracts, in electronic format for prospective bidders, Monday through Friday, 8:30 am through 4:00 pm, 2800 Berlin Turnpike, Newington, CT. The MW4 will be limited to one copy to the general contractor receiving official bid proposals only. Prospective bidders shall submit the signed Confidentiality Agreement along with the Part C Request for Bid Proposal form and contact the Office of Contracts at 860-594-3127 or 860-549-3129 to arrange to receive their copy of the MW-4.

347 Madison Avenue
New York, NY 10017-3739
212 340-3000

Howard Permut
President

Metro-North Railroad

CONFIDENTIALITY AGREEMENT

Name and Address of Company Executing this Agreement:

_____

_____

_____

WHEREAS, the Metropolitan Transportation Authority Metro-North Commuter Railroad Company (hereinafter referred to as "Metro-North") issued a Project Solicitation requesting bids **for the Independent Wheel True Facility, Project 300-0139 (the "Project Solicitation"); and**

WHEREAS, the Company executing this Agreement (hereinafter referred to as the "Contractor") is considering submitting a bid or is an agent or representative of a Contractor that is considering submitting a bid in response to the Project Solicitation; and

WHEREAS, Metro-North has agreed to provide the Contractor with information and documents that Metro-North considers to be confidential (hereinafter referred to as "Confidential Information");

NOW, THEREFORE, the Contractor agrees as follows:

1. Metro-North will provide the Contractor with access to and copies of Confidential Information solely for the purposes of the Contractor deciding whether to submit a bid in response to the Project Solicitation and/or preparing a bid in response to the Project Solicitation.

2. The Contractor agrees to keep in confidence and prevent the use (except for a disclosure pursuant to Paragraph 3, below) or the disclosure to any person or persons outside the Contractor (or outside another Contractor that has also executed and submitted to Metro-North an agreement in the same form as this Agreement), and limit the disclosure inside the Contractor (or inside another Contractor that has also executed and submitted to Metro-North an agreement in the same form as this Agreement) to employees having a need-to-know, of all Confidential Information provided to the Contractor in connection with the Project Solicitation.

3. In the event the Contractor provides any Confidential Information to a subcontractor or consultant in furtherance of the conduct of business stated above, the Contractor shall require that each such party reads this Agreement and agrees, in writing, to be bound by the terms of this Agreement as if such party were an original party to this Agreement.

4. The above restrictions on use and disclosure shall not apply to such Confidential Information if the same:

a. Is in the public domain or in the possession of the Contractor without restriction at the time of receipt under this Agreement;
b. Becomes known to the Contractor from a source other than Metro-North without breach of this Agreement by the Contractor; or
c. Is made available by Metro-North on an unrestricted, non-confidential basis.

5. Upon Metro-North's request, the Contractor shall return all Confidential Information received in written or tangible form, including copies, photographs, drawings, reproductions or other media containing Confidential Information, within five (5) business days of such request. At Metro-North's sole option, any such Confidential Information may instead be destroyed by Contractor. The Contractor shall provide a written statement to Metro-North regarding destruction within five (5) business days thereafter.

6. The Contractor shall provide Metro-North with immediate notice of any actual or potential requirement of any court or agency to disclose Confidential Information and shall permit Metro-North to seek a protective order or other lawful relief limiting such disclosure and will cooperate with Metro-North in obtaining such relief.

7. It is agreed that a violation of any of the provisions of this Agreement will cause irreparable harm and injury to Metro-North and that Metro-North shall be entitled, in addition to any other rights and remedies it may have at law or in equity, to an injunction enjoining and restraining the Contractor from doing or continuing to do any such act and any other violations or threatened violations of this Agreement.

8. The construction, interpretation and performance of this Agreement shall be governed by and construed in accordance with the laws of the State of New York without regard to any conflicts of law principles that would require the application of the laws of any other jurisdiction and subject to the exclusive jurisdiction of its federal or state courts in New York. Any suit brought for claims arising out of this Agreement shall be brought in the Supreme Court of the State of New York, New York County, or, if applicable, the United States District Court for the Southern District of New York.

9. This Agreement may be executed originally or by facsimile, and when so executed shall be deemed to be an original. It shall become binding on the Contractor when executed by the Contractor.

10. The rights, obligations, and other interests of the Contractor shall not be assigned by the Contractor, in whole or in part, without the prior written consent of Metro-North and any purported assignment of same shall be void. This Agreement shall be binding on successors and permitted assigns of the Contractor.

11. This Agreement is the entire agreement with respect to nondisclosure of Confidential Information pertaining to the conduct of business stated above and supersedes all prior agreements and understandings with respect to this subject. This Agreement may be amended only by written agreement executed by the Contractor and Metro-North.

12. The Contractor shall perform its obligations hereunder without charge to Metro-North.

13. The Consultant shall notify Metro-North promptly, to be followed by written notice of any loss or misplacement of Confidential Information, in whatever form.

14. All hardware, software, documents and other information received by or generated by the Contractor in connection with the Project Solicitation, unless otherwise indicated, shall be considered Confidential Information.

15. The Contractor shall send via registered mail or hand delivery all Confidential Information and any copies thereof, in whatever form, promptly upon Metro-North's request.

Signature of Authorized Employee of the Contractor:

_____

Print Name

_____

Signature

_____

Date

SECTION 1.05 – CONTROL OF THE WORK

1.05.02--Plans, Working Drawings, and Shop Drawings:

Delete the entire subsection entitled "3. Shop Drawings:"

1.05.06--Cooperation With Utilities (including Railroads):

Add the following after the last paragraph:

"Special Requirements Regarding Work in Metro-North territory:

Description:
This section covers authority, definitions, regulatory requirements, traffic regulation and coordination of the Contractor's work schedule with the operation of train service, construction equipment and safety requirements for working within railroad right-of-way, and provisions for storage of materials and equipment and worker safety rules. Subsequent to the Engineer's Pre-Construction Meeting and prior to commencement to Contract activities, the Engineer will hold a Working on the Railroad Meeting to emphasis these Specifications.

Metro-North Commuter Railroad Company – Permission to Enter Upon Railroad Property
Permission is hereby granted to the Contractor to enter property of the State of Connecticut, under the custody and control of the Connecticut Department of Transportation (hereinafter called "ConnDOT") and managed by Metro-North Commuter Railroad Company (hereinafter called "Railroad"), a public benefit corporation and subsidiary of Metropolitan Transportation Authority (hereinafter called "MTA"). The purpose of this permission shall be solely for the purposes outlined in this Contract and under the following terms and conditions:

1. Location and Access. Permission is hereby granted to the Contractor and its subcontractor(s), if any, to enter the property within the Project Limits identified on the Contract Plans (hereinafter called the "Property").
2. Liability. The Contractor covenants and agrees to at all times indemnify, protect and save harmless MTA, Railroad, National Railroad Passenger Corporation ("AMTRAK"), Housatonic Railroad Company ("Housatonic"), Providence & Worcester Railroad Company ("P&W"), and ConnDOT from and against any and all losses, damages, detriments, suits, claims, demands, costs, and charges which MTA, Railroad, AMTRAK, Housatonic, P&W, or ConnDOT may directly or indirectly suffer, sustain, or be subjected to by or on account of Contractors entry upon, occupancy or use of the Property, or the conduct thereon of the Contractor, its subcontractors, officers, employees, agents or invitees, whether such loss or damage be suffered or sustained by MTA, Railroad, AMTRAK, Housatonic, P&W or ConnDOT directly or persons (including employees of MTA, Railroad or ConnDOT or Corporations who may seek to hold MTA, Railroad, AMTRAK, Housatonic, P&W or ConnDOT liable therefor), and whether attributable to the

fault, failure or negligence of MTA, Railroad, AMTRAK, Housatonic, P&W or ConnDOT or otherwise.

3. Consideration. The Contractor will pay to the Railroad, the sum of Zero Dollars ($0.00) for the right to enter upon the Property.
4. Terms of Permit. The Railroad reserves the right to revoke this permission at any time. Unless subsequently modified, this shall begin with notice to proceed and shall end at Contract completion at which time it shall expire automatically. Under no circumstances shall this temporary permission be construed as granting the Contractor any rights, title or interest of any kind or character in, on, or about the land or premises of MTA or Railroad thereafter. The Permittee agrees to notify the Railroad when use of the Property or work is completed.

DEFINITIONS:

Railroad - Whenever the term "Railroad" is used without further qualification, it shall be taken to mean Metro-North Railroad.

On or Adjacent to - shall be interpreted to include space on, above and below railroad right-of-way operated by Metro-North, as well as space on, above, and below adjacent property which Metro-North determines to affect the safe operations of railroad service.

The Safety Rules - All work shall be performed in accordance with rules, regulations, procedures, and safe practices on the Railroad, FRA, OSHA, NESC and all other government agencies having jurisdiction over this Project.

Authority of the Engineer - This supplements Article 1.05.01 in that all Contract work upon or affecting railroad property, right-of-way or facilities, shall also be subject to the approval of the Chief Engineer, Maintenance of Way of the Railroad or its duly authorized representative, through coordination with the Engineer.

Coordination of Work - The Contractor shall be responsible for the coordination of the work of its subcontractors with respect to the railroad property, right-of-way or facilities.

Track - The space between the rails plus not less than 4-ft outside each rail.

Horizontal Clearance Point - A point 10-ft from the centerline of a track.

Vertical Clearance Point - A point 22’-6” above the top of a running rail unless otherwise authorized by Metro-North.

Traffic Envelope - The area encompassed by the vertical and the horizontal clearance points.

Obstruction - An entering of the traffic envelope, also referred to as fouling.

Occupancy - Any use of track other than direct crossing.

Right-of-Way - The limits of railroad property on either side of tracks.

Use of Track - Obtaining permission from the proper authority at Metro-North for track occupancy.

Conductor/Flagman - A Metro-North employee qualified on the Rules of the Operating Department and qualified on the physical characteristics of the portion of the railroad involved. They are the contact employee qualified to obtain the use of track. Each conductor/flagman will have the proper flagging equipment, up-to-date Metro-North Operating Rules, Metro-North Timetables and Metro-North Safety Rules.

Groundman - Class “A” employee of Metro-North’s Power Department authorized to de-energize/re-energize and ground high-tension power lines.

Qualified Metro-North Employee - For the purpose of these instructions, a qualified employee is a Metro-North employee qualified to remove track or tracks from service.

1.0 REQUIREMENTS FOR PERFORMING WORK ON OR ADJACENT TO THE RIGHT OF WAY OF THE RAILROAD

1.1 General

1.1.1 The Contractor should note that the proposed work involves construction operations on or adjacent to property owned by ConnDOT and operated by Metro-North Railroad. In working near an operating Railroad, great care must be exercised and the Railroad's safety rules must be strictly observed.

1.1.2 If while completing the work covered by this Contract, the tracks or other facilities of the Railroad are endangered, the Contractor shall immediately do such work as directed by the Railroad through the Engineer to restore safety. Upon failure of the Contractor to carry out such orders immediately, the Railroad may take whatever steps as are necessary to restore safe conditions. The cost and expense to the Railroad of restoring safe conditions, or of any damage to the Railroad's trains, tracks or other facilities caused by the Contractor's or subcontractor's operations, shall be considered a charge against the Contractor and shall be paid for by him, or may be deducted from any monies due or that may become due him under this Contract.

1.2 Rules and Regulations

1.2.1 Railroad traffic shall be maintained at all times, and the Contractor shall conduct all of its operations on or adjacent to the Railroad right-of-way fully within the rules, regulations, and requirements of the Railroad. The Contractor shall be responsible for acquainting himself with such requirements as the Railroad may demand. The Contractor shall include in its bid any expenses occasioned by delay or interruption of its work by reason of the operation or maintenance of the Railroad facilities.

1.2.2 The Contractor shall obtain verification of the time and schedule of track occupancy from the Railroad before proceeding with any construction or demolition work on or adjacent to the Railroad right-of-way.

1.2.3 All work to be done on or adjacent to the Railroad right-of-way shall be performed by the Contractor in a manner satisfactory to the Railroad and shall be performed at such times and in such manner as not to interfere with the movement of trains or traffic upon the tracks of the Railroad. The Contractor shall use all necessary care to avoid accidents, damage, delay or interference with the Railroad's trains or property.

1.2.4 If deemed necessary by the Railroad, it may furnish or assign an inspector who will be placed on the work during the time the Contractor or any subcontractor is performing work under the Contract on Railroad property.

1.2.5 Before proceeding with any construction of demolition work on or adjacent to the Railroad's property, a pre-construction meeting shall be held at which time the Contractor shall submit for approval of the Railroad, Plans, computations, and a detailed description of its method of procedure for accomplishing the specific construction work required under this Contract, including methods of protecting Railroad traffic. Such approval shall not serve in any way to relieve the Contractor of its complete responsibility for the adequacy and safety of its methods of procedures.

1.2.6 The Contractor shall conduct its work and handle its equipment and materials so that no part of any equipment shall foul an operated track or wire line without the written permission of the Railroad.

1.2.7 Equipment shall be considered to be potentially fouling the track when located in such a position that failure of same with or without load brings the equipment within the traffic envelope. No equipment shall be placed in this position without prior approval of the Railroad.

1.2.8 Equipment of the Contractor to be used:

1.2.8.1 Equipment of the Contractor to be used adjacent to the tracks shall be in first-class condition so as to fully prevent failures of defective equipment that might cause delay in the operations of trains or damage to Railroad facilities. Its equipment shall not be placed or put into operation adjacent to tracks without first obtaining permission from the Railroad. Under no circumstances shall any equipment or materials be placed or stored within 25-ft from the near rail of a track in operation, unless approved in advance by the Metro-North representative.

1.2.8.2 High rail equipment of the Contractor to be used on the tracks shall be subject to prior approval of the Railroad. The equipment must be inspected and approved in advance at Metro-North's facility by Metro-North inspectors.

1.2.8.3 On track vehicles shall be equipped with a MNR approved tow bar and coupler. Multiple vehicles shall move in tandem and coupled when directed by Metro-North. Movement of on track vehicles shall proceed only under the direct supervision of a qualified MNR employee.

1.2.9 Materials and equipment belonging to the Contractor shall not be stored on Railroad property without first having obtained permission

from the Engineer and Railroad, and such permission will be on the condition that the Engineer and Railroad will not be liable for damage to such materials and equipment from any cause. The Contractor shall keep the tracks adjacent to the site clear of all refuse and debris that may accumulate from its operations and shall leave the Railroad property in the condition existing before the start of its operations.

1.2.10 The Contractor shall coordinate with the Engineer and the Railroad in order to determine the type of protection required to insure safety and continuity of Railroad traffic incident to the particular methods of operation and equipment to be used on the work.

1.2.11 The Railroad will require protection during all periods when the Contractor is working on, or over, the right-of-way of the Railroad, or as may be found necessary in the opinion of the Railroad. When protection is required, refer to Paragraph 1.7.

1.2.12 It shall be expressly understood that this Contract includes no work for which the Railroad is to be billed by the Contractor, and it shall be further understood that the Contractor is not to bill the Railroad for any work which he may perform, unless the Railroad gives a written request that such work be performed at its expense.

1.2.13 Upon completion of the work, and before final payment is made, the Contractor shall remove from within the limits of the Railroad's right-of-way, all machinery, equipment, surplus materials, falsework, rubbish and temporary buildings, and other property of the Contractor/sub-contractor, and shall leave the right-of-way in a condition satisfactory to the Railroad.

1.3 Railroad Protective Services: Railroad protective services will be provided in accordance with the Roadway Worker's Protective Act, Title 49, Part 214, Sub-part C. Railroad protective services will also be performed to insure safe operations of trains when construction work would, in the Railroad's opinion, be a hazard to Railroad operations.

1.4 Definition of Hazard: Metro-North has furnished the statements quoted below explaining when they consider a hazard to operations exists.

"Protective services will be required whenever the Contractor is performing work on or adjacent to the Railroad tracks or right-of-way, such as excavating, sheeting, shoring, erection and removal of forms, handling materials, using equipment which by swinging or by failure could foul the track, and when any other type of work being performed, in the opinion of the Railroad, requires such service."

1.5 Contractor Requirements for Work Affecting the Railroad

1.5.1 All matters requiring Railroad Company approval or coordination shall be directed to the Engineer or a duly authorized representative thereof, for forwarding to Metro-North Railroad.

1.5.2 Detailed plans and appurtenant data and calculations for any operation which, in the opinion of Metro-North, affect the Railroad, must be submitted to the Engineer or a duly authorized representative thereof, for forwarding to Metro-North Railroad for approval prior to commencement of the work. A Connecticut registered Professional Engineer must stamp all plans and calculations submitted.

1.5.3 Permissible Track Outages: Permissible Track Outages are identified in the NOTICE TO CONTRACTOR – WORK ON RAILROAD PROPERTY_contained within the Provisions of the Contract. The times identified are the times that the track can be removed from service. If power outages are required, the grounding of the wires will subtract approximately 30 minutes from the outage time.

1.5.4 The Contractor shall maintain a minimum of 12-in level shoulder from ends of ties to maintain lateral track support for all excavations and shall not excavate any slope steeper than 1 (vertical) on 2 (horizontal) from the edge of the shoulder. Sheeting shall be required on all excavations where the side of the excavation is intercepted by the Railroad live load influence line. The live load influence line is defined as a line originating at the bottom edge of tie and extending downward at a slope of 1 (vertical) on 1½ (horizontal). Such excavations must be designed to withstand, in addition to all common loads such as soil pressure and hydrostatic pressure, a railroad live load of Cooper E-80.

1.5.5 The Contractor shall be required to design and install protective scaffolding over the right-of-way where, at the sole discretion of the Railroad, such scaffolding is necessary to protect the Railroad from possible falling debris; paint or other materials; to protect personnel working about the right-of-way or to provide a platform for personnel, materials and/or equipment. Said scaffolding shall be designed for live load of 200 lbs./sq. ft applied uniformly over the entire structure and a 2 kips concentrated load placed anywhere on the structure. The two loads are not to be applied simultaneously for design purposes.

1.5.6 All excavation areas within or near interlocking limits shall be located by the Contractor and inspected by Metro-North Railroad for the purpose of determining conflicts with underground facilities.

Exploratory trenches, 36-in deep and 15-in wide in the form of an "H" with outside dimensions matching and outside of sheeting dimensions are to be hand dug, in areas where railroad underground installations are known to exist. These trenches are for exploratory purposes only and are to be backfilled and compacted immediately. All work outlined above must be done in the presence of a Railroad inspector.

1.5.7 Cavities adjacent to sheet piling, created by driving of sheet piling, shall be filled with sand and any distributed ballast must be restored and tampered immediately.

1.5.8 Sheet piling shall be cut off at top of tie during construction and at 36-in below bottom of tie after construction just prior to completion of back filling.

1.5.9 Plans and calculations for sheeting and scaffolding must be submitted to the Engineer for forwarding to the Railroad for approval prior to construction. A Connecticut registered Professional Engineer must stamp plans and calculations.

1.6 Requirements for Erection, Demolition and Other Rigging Operations On or Adjacent to Railroad Right-of-Way: The Contractor shall be required to furnish the following information to the Engineer or a duly authorized representative thereof, for forwarding to Metro-North Railroad for their approval prior to the start of any rigging operation over or adjacent to the Railroad right-or-way:

1.6.1 Plan view showing locations of cranes, boom length and rigging operating radii, with delivery or disposal locations shown.

1.6.2 Crane rating sheets showing crane(s) to be adequate for 150% of the lift. Crane and boom nomenclature is to be indicated.

1.6.3 Plans and computations showing weight of pick.

1.6.4 Location plan showing obstructions, indicating that the proposed swing is possible.

1.6.5 Plans showing locations and details of mats, planking or special decking as may be required by the Railroad.

1.6.6 Written statement from crane owner giving date of last crane condition and safety inspection and the results of said inspection.

1.6.7 Data sheet listing number, type, size and arrangement of slings, spreader bars or other connecting equipment. Include copies of catalog or information sheets of specialized equipment. All such equipment shall be shown adequate to safely carry 150% of the calculated loading.

1.6.8 A complete procedure is to be included, indicating the order of lifts and repositioning or rehitching of the crane or cranes.

1.6.9 Temporary support of any components or intermediate stages is to be shown.

1.6.10 A time schedule of the various stages must be shown, as well as a schedule for the entire lifting procedure.

1.6.11 A Connecticut licensed Professional Engineer must stamp all erection, demolition and rigging plans and calculations submitted to the Railroad.

1.6.12 Operations directly on or adjacent to the operating right-of-way will be performed only at times and under conditions specified by the Railroad's representative.

1.7 Ordering Protective Personnel: Metro-North will furnish protective personnel (flagmen, inspectors, maintenance personnel and similar labor) to protect the operation of train traffic during the Contractor's construction activities. Railroad protective services will also be provided in conformance with the Roadway Worker's Protective Act. There will be no charge to the Contractor for Metro-North protective personnel. It is agreed that the providing (or failure to provide) of any conductors, flagmen, groundmen or other employees shall not relieve the Contractor from liability or payment for any damage caused by its operations.

1.7.1 The Contractor must obey all instructions from Metro-North representatives on the job site promptly. Failure to follow instructions shall be deemed sufficient cause for closing the job site to the Contractor and its employees.

1.7.2 The Railroad will at its sole discretion, determine the need for and the availability of protective, support personnel. The Railroad will provide protective forces to the extent possible considering operational and maintenance priorities. The Railroad makes no guarantee that protection personnel will be available to meet the Contractor's preferred schedule. Further, no such work may actually commence until the assigned Railroad representative affirmatively advises the Contractor that the necessary protective forces are stationed and that he may proceed.

1.7.3 The assessment of the need for protective services will be based upon a Weekly Railroad Coordination Meeting. At these meetings the Contractor shall provide a Bi-weekly Schedule that will begin on the following Saturday. The furnishing of these schedules shall be in accordance with other Contract provisions. Based on that schedule the Railroad will determine the Protective Service required for the two-week period. Protective services will be reserved for the following week beginning on the Saturday and ordered for the second week of the schedule. It will be the Contractor's responsibility to perform work in accordance with its approved schedule. Variations from the approved schedule may result in

additional and unnecessary costs to the Engineer, Railroad and Contractor.

The Contractor shall base its operations on a 5-consecutive-day work week. The hours of operation during this time shall remain constant. Multiple shifts may be worked.

The Contractor must demonstrate maximum use of protective service personnel ordered. Failure to do so may cause the inability to consistently obtain services.

1.7.4 Requests to cancel construction activities and subsequently, the scheduled protective personnel will be also determined at the Weekly Railroad Coordination Meeting held on the Tuesday. At these meetings, the previously scheduled protective service for the week beginning on the following Saturday may be canceled. This will be the only time for cancellation. No ordering of Protective services for the following week will be allowed.

1.7.5 The Contractor shall be held responsible for its subcontractors and suppliers. Weather conditions are considered the only acceptable excuse for nonperformance and only on work items that have been identified and agreed to have been weather dependent when scheduled. Activities not presented on the Bi-weekly schedule at the Railroad Coordination Meeting will not be able to commence until it has been inserted into the schedule and presented at the next Protective Service Meeting.

1.7.6 Work that requires the support of Railroad personnel shall not be scheduled on the following days, unless the work is of an emergency nature:

New Year's Day
President's Day
Good Friday
Memorial Day
Independence Day
Labor Day
Thanksgiving Day
Day Following Thanksgiving Day
Christmas Eve
Christmas Day
New Year's Eve
The Saturday and Sunday preceding a Monday holiday.
The Saturday and Sunday following a Friday holiday.
The Friday and Monday preceding and following a weekend holiday.

1.8 Requirements for Requesting Track Outages

Track outages as described in the plans and specifications must be requested at the weekly Railroad Construction Coordination Meeting held on the Tuesday for the following week (Saturday through Friday) in which the outage is requested.

1.8.1 All procedures, material and equipment must be approved and on site prior to accepting the track outages request.

1.8.2 Track outages will be granted based on need for constructablity not for convenience.

1.8.3 The Contractor must demonstrate the maximum use of track outages by coordinating its activities and work so that various elements and multiple activities are performed during approved outages. Failure to consistently utilize track outages may cause the inability to gain approval of future requests for outages.

1.8.4 No new track outages may be initiated the weekend preceding or following the following holidays: Thanksgiving, Christmas, and New Year's. However, long-term continuous outages may extend through these periods.

1.9 Catenary and Transmission Systems/Power Outages

1.9.1 Catenary and Transmission Systems - The Contractor shall assume that all the wires on the Railroad Company are energized at all times and must be governed by the restrictions imposed by the Railroad with respect to such electrical circuits. Should it become necessary, in the opinion of the Railroad Engineer to de-energize any wire or wires to insure safety of operation, such wires will be de-energized by the Railroad only during such period that will not interfere with the Railroad's operation. When the de-energizing and re-energizing of wires is deemed necessary, a representative of the Power Department of the Railroad must be on duty and present to arrange for the same. He will notify the Contractor in writing when the wires have been de-energized and also when said wires are to be re-energized.

1.9.1.1 The Contractor is advised that the overhead electrification will remain in place for the duration of the entire project, except where called for on the drawings and in the specifications.

1.9.1.2 Track rails of the Railroad are energized. Particular care must be taken to see that no contact is made between adjoining rails with any material which is a good conductor

of electricity when dry, or material of any nature when wet. Particular care is necessary when any work involving the use of chains, steel rods, cables, pipes, etc., is done. Since the Contractor shall assume the wires and rails of the Railroad will be energized at all times, the Contractor shall require all of its employees, sub-contractors, and others to sign a form similar to the form shown in the NOTICE TO CONTRACTOR – WORK ON RAILROAD PROPERTY contained within the Provisions of the Contract.

1.9.2 Power Outages

1.9.2.1 Catenary Power Outages - A catenary power outage must be scheduled concurrently with a track outage for the track and is restricted to the same periods as specified in the plans and specifications.

1.9.2.2 Metro-North Railroad Power and Signal Distribution Feeder Outages - Outages for feeders can be allowed only during off-peak hours. These outages should be requested at the weekly Railroad Construction Coordination meeting held on the Tuesday for the following week (Saturday through Friday). One set (north or south) side of Railroad of power and signal feeders must be maintained energized at all times.

NOTE: During peak (5:00 a.m. to 10:00 a.m. and 3:30 p.m. to 10:00 p.m., Monday thru Friday) hours of Railroad traffic, both sets (north and south) of power and signal feeders must be energized.

1.10 Safety for Contractor's Employees Working on or Adjacent to the Right-of-Way of the Railroad

1.10.1 Personal Protection Equipment

1.10.1.1 Approved hard hats must be worn by all Contractor employees while on the right-of-way in yard, shop facilities, and construction and/or work sites. Approved safety eyewear must be worn by all Contractor employees while on right-of-way, in yard, shop facilities and construction and/or work sites and in the operating control cab of a moving locomotive or train. Department head and Director of Safety must jointly approve any exclusion.

1.10.1.2 Metro-North Safety Engineer approved reflectorized vest or clothing must be worn by all Contractor employees while on or about tracks and right-of-way and in yards.

1.10.1.3 Other protective equipment such as goggles, face shields, safety belts, floatation vests, gloves and respirators shall be issued by the Contractor when required. Protection devices for hearing conservation may be used when determined necessary and safe to do so.

1.10.2 Possession or use of Drinking Intoxicants and Narcotics

1.10.2.1 The use of intoxicants, narcotics, marijuana, amphetamines or hallucinogens or while on duty, is prohibited and is sufficient cause for dismissal. Contract employees under medication before or while on duty, must be certain that such use will not affect the safe performance of their duties.

1.10.3 Surveying Equipment

1.10.3.1 Measuring tape must be non-metallic to avoid shunting the signal system electric circuits. This will occur when a metallic object is laid across the top of two rails of any track.

1.10.3.2 Electrically rated fiberglass elevation rods are to be used to avoid injury in the event contact is made with energized catenary or signal/communication lines. Elevations of catenary wires must be obtained by or under direct supervision of a qualified Metro-North Class ”A” groundman.

1.10.4 On or About Track

1.10.4.1 Contractor employees must walk on tracks or cross tracks only when necessary, and when accompanied by or with permission from a qualified Metro-North employee.

1.10.4.2 Contractor employees must not enter track unless it is necessary in performance of their duty.

1.10.4.3 The possession of an umbrella on or about tracks is prohibited.

1.10.4.4 Do not rest any object on shoulder while close to moving train.

1.10.4.5 Expect equipment to move on any track, in either direction, at any time. Contractor employees must look in both directions and have permission from a qualified Metro-North employee before:

a. Fouling track
b. Crossing track

c. Going between or around end of equipment or structure
d. Moving out from between or under equipment of structure
e. Getting on or off equipment
f. Performing any other applicable operation

1.10.4.6 When crossing tracks have permission from a qualified Metro-North employee. Always use approved walkways when available; otherwise take the shortest safe route after looking in both directions. If more than one track is to be crossed, stop and look before crossing each track.

1.10.4.7 When required by a conductor/flagman or other qualified Metro-North employee to vacate tracks, the Contractor employees must comply immediately.

1.10.5 Catenary Electric Systems

1.10.5.1 All overhead wires must be considered energized (LIVE) at all times except when it is known they have been de-energized and properly grounded.

1.10.5.2 Until after wires are de-energized and properly grounded, all Contractor employees must not approach within 10-ft of transmission systems wires, catenary system or signal power wires.

1.10.5.3 At the beginning of each tour of duty, the Class "A" groundman will instruct the Contractor foreman and each Contractor employee in the crew of the dangers surrounding them, calling their particular attention to any hazards to be encountered by the nature of the work to be done.

1.10.5.4 If in the opinion of the Class "A" groundman, any Contractor employee in the crew does not understand the instructions due to not having a proper knowledge of the English language, or for any other reason, such person shall not be permitted to work, or observe.

1.10.5.5 When clearances have been obtained and the wires, equipment or apparatus properly grounded, the Class "A" groundman will indicate to the Contractor foreman and the crew the location of wires, equipment or apparatus from which power has been removed and the location of the grounding devices applied. The Class "A" groundman must obtain on standard form, the signature of the Contractor foreman indicating that he and the crew have

been so instructed, and will confine their work within the limits as outlined to them by the Class "A" groundman.

1.10.5.6 When the Class "A" groundman leaves its crew for any reason, he must notify the Contractor foreman and each person in the crew to stop all work in the vicinity of the wires, personally assuring himself that all persons have moved to a safe distance away from its departure. The Class "A" groundman will obtain the signature of the Contractor foreman on standard form, that he and the crew have been informed that the Class "A" groundman is leaving the gang and they will not resume work until advised to do so on return of the Class "A" groundman.

1.10.5.7 When the clearances are to be released, the Class "A" groundman will inform the Contractor foreman and each other Contractor employee and will personally observe that all persons have moved to a safe distance from the wires, equipment or apparatus to be energized, before removing the grounding devices. He will obtain the signature of the Contractor foreman, on a standard form, stating that he and the gang have been advised that the wires, equipment or apparatus will be energized, and that they will remain at a safe distance from them until informed otherwise by the Class "A" groundman.

1.10.5.8 The Class "A" groundman will inform the Contractor foreman if any Contractor employee on the job is unsafe and will not comply with instructions. If trouble is experienced with the Contractor foreman in maintaining safe working conditions, the Class "A" groundman will immediately notify its supervisor.

1.10.6 Aerial Catenary Construction by Qualified Contractor Employees

1.10.6.1 Aerial catenary work included in this Section shall include all overhead wire work included in the portion of the Contract.

1.10.6.2 Aerial catenary work by the Contractor shall be done in accordance with the Railroad's safety rules and in accordance with the NEC.

1.10.6.3 Due to the specialty nature of the work, limited construction periods available, and high quality of work required, the aerial catenary construction included within the Contract is to be done only by qualified Contractor employees. Only Contractor employees that meet the requirements of the International Brotherhood of Electrical Worker's standards for Journeyman Lineman and who have

successfully completed a Metro-North power orientation class shall be considered for the work of this Section. The power orientation class will be given periodically and will require less than one-half day to complete. Approval for qualification shall be determined by Metro-North and that approval shall not be unreasonably withheld.

1.10.6.4 Metro-North approved Journeyman Lineman shall be issued identification as workers qualified to perform aerial catenary work. Qualified Contractor employees shall work according to the Railroad's MN-290 Electrical Operating Instructions. Qualified employees are authorized and expected to work to within 36-in of 13.5 kV energized overhead catenary. Contractor employees shall not de-energize circuits, place initial grounds, or provide protection for others.

1.10.6.5 Apprentice Lineman shall be permitted to assist qualified Journeyman Lineman and work under their direct supervision. Apprentice lineman are prohibited from coming closer than 10-ft from all overhead wires or circuits regardless of whether they have been de-energized or not.

1.10.7 Safety Program and Plan

1.10.7.1 Prior to the commencement of work the Contractor shall submit a Working on the Railroad Safety Plan that will include a Program to implement the plan to the Engineer or a duly authorized representative for forwarding to the Railroad for review of compliance with this specification. This plan is separate to the Health and Safety Plan required for other aspects of the project (i.e., lead, excavations, etc.).

1.10.7.2 Each employee of the Contractor, subcontractor or others on site shall be given an initial training session prior to being allowed to work on the project, but not on the Railroad Right of Way, at this session the following will be furnished to the employee:

a. Safety Orientation for Contract Employees Working on Metro-North Property produced by the Safety Engineer of Metro-North.
b. Safety Inspection Checklist
c. List of the applicable publications referenced in these specifications with respect to safety and where they are located for review if necessary. The list shall include, but not be limited to, such regulatory

standards and mandates, i.e., OSHA, NIOSH, DOL, NFPA, EPA, FRA, MSDS, etc.

d. Copy of the applicable corporate safety plan.

e. Copy of the project Railroad Safety Plan or other project related plans.

The employee shall sign the standard form for acknowledgement of the above-noted documents.

1.10.7.3 As soon as possible after the initial training, the employee shall also be given a one-hour training session administered by Metro-North Safety Engineer or its representative. All employees receiving this training will receive a Registered Hard Hat sticker that will identify them from the employees with initial training on the project. No Contractor employees are permitted on the Railroad right-of-way without this training.

1.10.7.4 The Contractor shall hold "TOOL BOX" safety meetings for their employees at least once a week that will be documented and attendees listed.

1.10.7.5 The Contractor personnel shall attend a monthly Metro-North Safety Meeting.

2.0 INSURANCE REQUIREMENTS – METRO-NORTH RAILROAD

2.1 Submission of Insurance: The Contractor engaged in work on the project shall be required, before the Contractor begins work on the project, to provide and to maintain in force during the course of the project, at no cost to Metro-North, insurance described in Paragraph 2.2. These insurance policies are in addition to any other forms or insurance or bonds required under the Terms of the Contract.

2.2 Insurance: The Contractor shall furnish evidence that, with respect to the operations it performs, carries Workmen's Compensation Insurance and Public Liability and Property Damage Insurance covering all the Contractor's operations in any way connected with the project, and to furnish evidence of such policy to Metro-North.

2.2.1 Contractor's Public Liability and Property Damage Insurance – The Contractor shall furnish evidence that, with respect to the operations it performs, it carries regular Contractor's Public Liability Insurance providing for a limit of not less than $2,000,000 single limit, bodily injury and/or property damage combined, for damages arising out of bodily injuries to or death of all persons in any one occurrence and for damage to or destruction of property, including the loss of use thereof, in any one occurrence.

2.2.2 Contractor's Protective Public and Property Damage Liability Insurance – The Contractor shall furnish evidence that, with respect to the operations performed by Subcontractors, it carries in its own behalf regular Contractor's Protective Public Liability Insurance providing for a limit of not less than $2,000,000, single limit, bodily injury and/or property damage combined, for damages arising out of bodily injuries to or death of all persons in any one occurrence and for damage to or destruction of property, including the loss of use thereof, in any one occurrence.

2.2.3 Railroad's Protective Public Liability Insurance – In addition to the above, the Contractor shall furnish evidence that, with respect to the operations it or any of its subcontractors perform, it has provided Railroad Protective Public Liability Insurance (AAR-AASHTO Form) in the name of the Metro-North Railroad providing for a limit of not less than $2,000,000 single limit, bodily injury and/or property damage combined, for damages arising out of bodily injuries to or death of all persons in any one occurrence for damage to or destruction of property, including the loss of use thereof, in any one occurrence. Such insurance shall be furnished with an aggregate of less than $6,000,000 for all damages as a result of more than one occurrence. The named insured shall include:

Metro-North Commuter Railroad
Metropolitan Transportation Authority of New York
Connecticut Department of Transportation
Consolidated Rail Corporation
National Railroad Passenger Corporation
Providence and Worcester Railroad Company

The insurance hereinbefore specified shall be carried until all work on the project is satisfactorily completed and formally accepted. Failure to carry or keep such insurance in force until all work is satisfactorily completed shall constitute a violation of the project Contract.

The Contractor shall furnish to Metro-North a signed copy of the policy for Contractor's Public Liability Insurance and Protective Public Liability Insurance and the original copy of the Railroad Protective Public Liability Insurance. If any work is subcontracted, the Contractor shall furnish a signed copy of the policy for Contractor's Public Liability Insurance.

This policy shall be endorsed to the effect that for the purposes of this insurance, the employees of the Railroad Company, as listed below, shall be considered the same as regular employees of the Contractor:

2.2.3.1 Any watchman, flagman and similar employee who is employed by the Railroad Company and is specifically assigned or furnished by the Railroad Company for work in connection with the Project.

2.2.3.2 Any employee of the Railroad Company while operating the work trains or other equipment while engaged in the performance of work directly involved in this Contract.

2.2.4 The insurance described in Paragraphs 2.2.1, 2.2.2 and 2.2.3 above, shall be endorsed to provide for not less than 30 days advance written notice to Metro-North of any change or cancellation of policies. Said notice shall be sent to the individual identified in the NOTICE TO CONTRACTOR – WORK ON RAILROAD PROPERTY contained within the Provisions of the Contract. Work may not proceed on Metro-North property until all insurance requirements have been met to the satisfaction of Metro-North's Engineer.

3.0 COSTS ASSOCIATED WITH THIS SPECIFICATION

3.1 There shall be no direct payment for this work, regulatory requirements, traffic regulation, administering of the specification, coordination and incidentals to fulfill the requirements of this specification. The cost thereof will be considered as included in the general cost of the work and distributed in all items.

3.2 Any work, material's supplied, inspections and protective services by Metro-North as described in the plans and specification expressly needed for the construction of the project will be compensated by the Engineer on a separate agreement."

ITEM #0000591A – 3” PVC DUCT BANKS – 2 DUCTS

ITEM #0000580A – 4” PVC DUCT BANKS – 1 DUCT

ITEM #0000581A – 4” PVC DUCT BANKS – 2 DUCTS

ITEM #0000582A – 4” PVC DUCT BANKS – 4 DUCTS

ITEM #0000349A – 4” PVC DUCT BANKS – 8 DUCTS

ITEM #0000354A – 4” PVC DUCT BANKS – 12 DUCTS

ITEM #0000545A – 5” P.V.C. DUCT BANKS - 2 DUCTS

ITEM #0000546A – 5” P.V.C. DUCT BANKS - 4 DUCTS

ITEM #0000547A – 5” P.V.C. DUCT BANKS – 6 DUCTS

ITEM #0000426A – ELECTRIC HANDHOLE

ITEM #1010912A – ELECTRIC MANHOLE

ITEM #1010916A –CONCRETE MANHOLE

Description:

Scope

A. This Section specifies the furnishing, installation, connection, and site-specific detailed design of concrete-encased duct banks and precast concrete manholes and handholes as indicated on the Plans.

B. The Contractor shall perform additional underground exploratory investigations as indicated on the Plans (i.e., test pits, utility detection services, etc.) to determine a clear path/space for all new underground duct banks, manholes, and handholes. Revisions are to be made to the relevant Plans by the Contractor based on the underground exploratory investigations. These alterations are to be submitted to the designer, along with the accompanying duct bank profile and detail drawings, for approval prior to proceeding with the work in the field.

Related Sections

Related requirements are included in, but not limited to, the following:

A. "Trench Excavation 0'-10' Deep"

B. Special Provisions for Wire and Cable

References

A. All work furnished under this Section shall be in accordance with the latest applicable standards of ASTM, NEMA, UL, and National Electrical Code with regard to material, design, construction and testing, except for any specific variations provided in this Section. The standards applicable shall include, but not be limited to, the following:

Organization	Number	Title
AASHTO	M199	Reinforced Concrete Manhole Sections
AASHTO	HS20-44	Live Loads for Highway Bridges
ASTM	A48	Gray Iron Casting
ASTM	A438	Transverse Bending Test
ASTM	C136	Coarse Aggregates
ASTM	C150	Portland Cement
ASTM	C827	Early Volume Change of Cementitious Mixtures
NEMA	TC-6	Polyvinyl Chloride (PVC) Plastic Utility Ducts for Underground Installations
ANSI	C80.1	Rigid Galvanized Steel Conduit

Submittals

The Contractor shall submit the following:

A. Catalog data on metallic and non-metallic conduit, all conduit couplings and fittings, manhole and handhole inserts, cable support material, waterproofing sealer, concrete curing compound, and concrete dye additive.

B. Shop drawings of pre-cast manholes and handholes which show all accessories including layout of cable supports. The Contractor shall not commence the installation of the pre-cast manholes and handholes until the drawings are approved by the designer.

C. Conduit Stub-Up Plans: Include all locations where conduit transitions from below-grade to above-grade.

D. Detailed plan and profile installation drawings for duct banks and conduits, manholes, and handholes for the work shown on the Plans.

Materials:

Pre-cast Manholes and Handholes

A. Manholes/handholes may be constructed monolithically or in sections. All manholes and handholes shall be watertight. Splices in manholes and handholes shall be suitable for submersible use. If the manhole is constructed in sections, the joint between sections shall be made watertight with an approved gasket or with an approved epoxy mortar grout.

B. Manhole and handhole access openings shall be centered in the roof slab and duct bank knockouts shall be centered in the walls, unless otherwise noted. This shall be constructed in size and shape to accommodate the cast iron cover and frame as shown on the Plans.

C. Manholes and handholes shall include duct bank knockouts, riser conduit knockouts, a sump with galvanized grate and a minimum depth of two inches, a ground rod, 7/8-inch minimum diameter galvanized steel pulling irons (8 per manhole, 4 per handhole), cable racks, and cast iron cover with lifting hooks and/or finger holes.

D. Size: Minimum inside dimensions of manholes/handholes shall be as indicated on the Plans.

E. Design Loads: Manhole and handhole design loads shall consist of live loads, live load impact, dead load, soil loads, hydrostatic loads and any other expected loads that may occur.

1. Live loads shall be for Cooper E-80 for manholes and handholes. All structures shall be designed to accommodate loading applied at a distance of 4’-3” from the centerline of track.

2. Impact loading shall be 30 percent of the live loads.

3. Soil loads shall consist of an earth cover over manhole from zero (0) feet minimum to five (5) feet maximum. Average unit weight of earth shall be assumed to be 100 lbs. per cubic feet.

4. Hydrostatic loading shall be a hydrostatic head of nine (9) feet above base of manhole.

F. The final production shop drawings shall be approved and signed by a Civil or Structural designer registered in the State of Connecticut.

G. Concrete: Cement for concrete shall be Portland cement, meeting the requirements of ASTM C150, Type I or Type II. Concrete shall be thoroughly cured and shall attain a compressive strength of at least 5,000 psi prior to delivery.

H. Concrete reinforcing bars (if required) shall be in accordance with the provisions of the Contract Documents.

I. Exterior surfaces of manholes/handholes shall be waterproofed with two coats of waterproofing sealer. The sealer shall be applied when the man-holes/handholes are manufactured and touched up in the field as required to repair damage during shipping and to seal field penetrations. The sealer shall be applied in accordance with the manufacturer's recommendations.

J. Ground rods shall be in accordance with the "Notice to Contractor – Grounding and Bonding Systems."

Manhole and Handhole Frames and Covers:

A. Handhole frames and covers shall be as indicated on the Plans. Manhole frames and covers shall be cast from gray iron in accordance with the applicable requirements of ASTM A48, Class 30. Inscription on manhole covers shall be as indicated on the Plans. All frames and covers shall be rated "heavy duty" or stronger. All castings shall, at a minimum, be able to withstand AASHTO HS-20 traffic loading. The transverse bending test shall be considered the primary test for qualification and shall be conducted in accordance with the requirements of ASTM A-438.

B. Cleaning and Inspection:

1. All castings which have passed the required tests shall be thoroughly cleaned, inside and out, without the aid of acid or other liquid, and shall be subjected to careful inspection and hammer tests.

2. The castings shall be of the dimensions indicated on the Plans and shall be free from sand or blowholes and cold shuts. No plugging or stopping of

holes will be allowed. Casting lines and excess materials shall be ground smooth.

Manhole/Handhole Cable Supports

A. Cable racks shall be surface-mounted with stainless steel bolts to ½ inch stainless steel anchor inserts and installed vertically, approximately two feet apart on each wall, without blocking any duct bank openings for the new or future duct banks.

1. The exact locations and quantity of cable racks depend upon the exact locations of the pre-cast duct bank knockouts in each style of manhole/handhole and shall be subject to approval by the Engineer.

2. Cable racks shall be heavy duty non-metallic UL listed glass reinforced polymer, Underground Devices Inc. or approved equal. The cable racks shall consist of:

a. A 36 inch long stanchion that shall be attached to the manhole/handhole wall in accordance with the manufacturer's recommendations and shall incorporate recessed bolt mounting holes and multiple arm mounting holes that are four (4) inches apart.

b. Adjustable arms that lock into the stanchion. Holes or slots shall be provided in the arms for cable wire ties. Cable rack arm lengths shall be appropriate for the manhole/handhole size and amount of cable being installed.

B. The Contractor shall furnish manhole/handhole hardware, as specified hereinafter, or approved equal. Drop-in anchors shall have a 1/2-13 thread, a rated pullout working capacity of at least 2100 pounds and shall be made from either 303 or 316 stainless steel. A 316 stainless steel 1/2-13 hex head cap screw and a 316 stainless steel flat washer shall be used with each drop-in anchor.

Waterproofing

A. Sealer for waterproofing exterior surfaces of manholes/handholes shall be a mineral colloid type asphalt emulsion, as manufactured by Hunt Process Company "Aqua Shield 124," or approved equal.

Aggregate Base

A. Aggregate bases for manholes shall be gradation No. 6 crushed stone. Each manhole shall have a twelve (12) inch minimum deep base. Each handhole shall have eight (8) inch minimum deep base.

Grout

A. Non-shrinking, non-metallic grout shall be in accordance with ASTM C150 premixed compound capable of minimum compression strength of 4,000 pounds per square inch (psi).

B. Water shall be clean and free from deleterious substances.

C. Non-metallic non-shrinking grout shall be factory pre-mixed requiring only water addition in the field.

D. Shrinkage, if any, shall be in accordance with ASTM C827.

Underground Duct Work

A. All underground duct work shall be schedule 80 PVC unless noted otherwise. All stub-up conduit sweeps shall be large radius (48 inches minimum) unless noted otherwise.

B. Duct sizes shall be as indicated on the Plans.

C. Reinforcement is required continuously for entire run of ductbank.

D. Concrete Encasement: Concrete encasement for these duct banks shall contain Class "C" concrete and shall have a compressive strength at age 21 days of not less than 3000 psi. The maximum size of aggregate shall be ¾ inch. The concrete shall be dyed a "Red" color with an approved concrete additive. Slump shall be between four (4) and six (6) inches. Forming material is not required during the construction of duct banks. The contractor shall use any means deemed acceptable by the Engineer to construct the duct bank to the dimensions and grades as shown on the plans. Trench forming will be considered an acceptable method.

E. Conduits: PVC and RGS conduits and fittings shall be as specified herein. Asbestos cement conduit or fittings are prohibited.

F. Separators: Conduit separators or spacers shall be non-metallic and of the type recommended by the conduit manufacturer.

Backfill

A. Backfill material shall be in accordance with applicable parts of the Contract Documents and approved by the Engineer.

Marker

A. Duct markers shall be located at the ends of all conduit runs except at structures, at approximately every 200 feet along the conduit run, and at each change in direction of the conduit run. Markers shall be placed approximately 2 feet to the right of the conduit when facing the longitudinal axis of the run and in the direction of the electrical load. Markers shall be made of Class "C" concrete and shall have a compressive strength at age 28 days of not less than 3000 psi. Markers shall be a 6 inch square or round section by 2 feet long. The top edges of the marker shall have a 1/2 inch chamfer all around. The letter "D" with two arrows shall be impressed or cast on top of the marker. One arrow shall be located below the letter and shall point toward the ducts. The second arrow shall be located adjacent to the letter and shall point in a direction parallel to the ducts. The letter and the arrows shall be V shaped and shall have a width of stroke at least 1/4 inch at the top, and depth of 1/4 inch. The top of the markers shall be flush with the adjacent elevation of the paved or unpaved areas. Where the duct bank changes direction, the arrow located adjacent to the letter shall be cast or impressed with an angle in the arrow approximately the same as the angular change of the run. Marker tape shall be Greenlee No. 435, or approved equal.

Construction Methods:

Excavation and Backfill

A. Excavation and backfill shall be performed in accordance with the Contract Documents and approved by the Engineer.

Installation of Manholes and Handholes

A. The Contractor shall install concrete manholes/handholes as indicated on the Plans and as approved by the Designer.

B. Prior to burial and installation, field-apply two (2) coats of concrete sealer to exterior surfaces of the manhole around the duct bank penetrations, conduit penetrations, frame, and field joints. Sealer shall be applied in accordance with the manufacturer's recommendations and must be of high quality to prevent water entry.

C. Manhole cover and frame shall be installed as shown on the approved shop drawings. Cover frame shall be adjusted level and flush with finished grade.

D. Weld manhole identification names to each cover. The identification names shall be recommended by the Contractor and approved by the Designer prior to procuring manholes.

E. Install a ground rod in each manhole so that eight inches of the ground rod protrudes above the concrete floor and seal around ground rod with grout finished to match floor. Bond ground rod to metallic cable supports, rigid steel conduit terminations and other metallic components with #4/0 AWG bare copper cable per the "Notice to Contractor – Grounding and Bonding Systems."

F. Connections to Manholes: Duct bank envelopes connecting to manholes shall be flared to have an enlarged cross-section at the manhole opening dimensions by no less than twelve (12) inches in each direction. The perimeter of the duct bank opening in the manhole shall be flared toward the inside or keyed to provide for a positive interlock between the duct bank and the wall of the manhole. Vibrators shall be used when this portion of the envelope is poured to assure a seal between the envelope and the wall of the manhole

Installation of Conduits and Duct Banks

A. Conduits shall be installed as shown on the Plans. Duct bank configuration may be adapted to route obstructions such as underground utilities per the designer's approval; such adaptations may include rotating and fanning out of ducts.

B. Conduits: Minimum burial depth of duct bank from final grade to top of concrete shall be 24 inches when not under track, and 36 inches from the bottom of tie to the top of concrete when located under tracks. The contractor shall coordinate installation of conduits with the designer.

C. The manufacturer's directions shall be followed in placing all conduits, fittings, supports and spacers, and in compensating for temperature effects.

D. Spacers shall be placed at not greater than five (5) feet intervals on center. Use of metallic spacers will not be permitted. Spacer system shall be designed to support duct bank longitudinal reinforcing bars. Unless noted otherwise on the Plans, install one (1) #5 longitudinal reinforcement bar through the spacers at each of the four outer corners of the duct bank, providing a minimum of one (1) inch of

concrete cover over the bars. The duct bank and spacing details shall be as shown on the Plans.

E. For concrete-encased duct banks, the contractor shall completely encase the duct bank without disturbing its vertical or horizontal alignment or damaging the conduits.

F. The exposed surface of duct encasement concrete shall be floated smooth after placement, and an approved curing compound shall be applied in conformance with the concrete manufacturer's recommendations.

G. At all stages of the work, the Contractor shall exercise care to prevent foreign materials from entering the ducts.

H. Following installation, each conduit shall be thoroughly cleaned and then tested by the successful pulling of a brush and mandrel approved by the Engineer. The mandrel shall be not less than ¼ inch smaller than the inside nominal diameter of the conduit. The Contractor shall give the Engineer 24 hours notice prior to witness the cleaning and testing.

I. A 1/8-inch nylon pull rope shall be installed in each conduit run and secured at each end.

J. All conduit terminations shall be plugged using approved removable plugs.

K. Warning tape is to be installed in the fill over all duct banks at a depth of approximately one (1) foot below finished grade. This tape shall be over the longitudinal centerline of the duct banks and shall have appropriate language written on the tape that warns of the presence of cable duct banks below the tape and to not proceed with any excavation in the area.

L. Pulling tension of cable shall not exceed the cable manufacturer's recommendations.

M. Partially Completed Duct banks: During construction, wherever a construction joint is necessary in a duct bank, without exception always prevent debris such as mud, sand, and dirt from entering ducts by providing suitable conduit plugs. Fit concrete envelope of a partially completed duct bank with reinforcing steel extending a minimum of twenty-four (24) inches back into the envelope and a minimum of twenty-four (24) inches beyond the end of the envelope. Provide one No. 5 bar in each corner, three (3) inches from the edge of the envelope. Secure corner bars with two No. 3 ties, spaced approximately four (4) inches apart. Restrain reinforcing assembly from moving during concrete pouring.

N. Conduit Plugs and Pull Rope: New conduit indicated as being unused or empty shall be provided with plugs on each end. Plugs shall contain a weephole or screen to allow water drainage. Provide a plastic pull rope having thirty-six (36) inches of slack at each end of unused or empty conduits.

O. Duct bank and conduits shall slope down to prevent collection of water inside the conduit.

Method of Measurement:

A. Conduit and Duct Banks will be measured on a per "linear foot" basis. Measurement shall not occur until the task is complete, backfilled, proofed, and pull-strings installed.

B. Manholes and Handholes will be measured on a per "each" basis completely installed, electrically grounded, and fully connected to the incoming/outgoing duct banks and ready for the installation of cable..

Basis of Payment:

A. Conduit and Duct Banks will be paid for at the Contract unit price bid. This price shall be full compensation for all labor, equipment, materials and tools required to perform this work. Associated surface restoration shall be included in this price.

B. Manholes and Handholes will be paid for at the Contract unit price bid. This price shall be full compensation for all labor, equipment, materials and tools required to perform this work. Associated surface restoration, excluding pavement and sidewalks, shall be included in this price

C. Trench Excavation, Rock-in-Trench Excavation, No. 6 Crushed Stone, and Suitable Backfill Material shall be paid separately under the applicable Items.

Pay Item	Pay Unit
3" PVC Duct Banks – 2 Ducts	L.F.
4" PVC Duct Banks – 1 Duct	L.F.
4" PVC Duct Banks – 2 Ducts	L.F.
4" PVC Duct Banks – 4 Ducts	L.F.
4" PVC Duct Banks – 8 Ducts	L.F.
4" PVC Duct Banks – 12 Ducts	L.F.

5” P.V.C. Duct Banks - 2 Ducts	L.F.
5” P.V.C. Duct Banks - 4 Ducts	L.F.
5” P.V.C. Duct Banks – 6 Ducts	L.F.
Electric Handhole	EA.
Electric Manhole	EA.
Concrete Manhole	EA.

ITEM #0001130A - 500 KCMIL, 15 KV SHIELDED COPPER CABLE

Description:

Scope

This Section includes cables and related splices, terminations, and accessories for 15 KV shielded copper cable electrical distribution systems.

Quality Assurance

A. Cable Manufacturers' Qualification: Not less than fifteen (15) years experience in the actual production of the specified products.

B. Workmanship shall conform to the best modern practices in the manufacturing of a rugged, durable, and safe product for use in a public transportation system. Materials used shall be new and of the highest commercial grade as specified.

C. The Insulated Cable shall be manufactured and tested under the control of a Quality Assurance system that conforms to the requirements of ISO 9000.

D. The Quality Assurance system shall demonstrate conformance to the above criteria by having passed yearly quality audits conducted by outside independent organizations.

Submittals

The Contractor shall submit the following for review and approval of the designer at various stages of planning, manufacturing, and installation of cable and wire as requested:

A. Descriptive literature, catalog data, and other pertinent information for cable splices sufficient to clearly demonstrate compliance with the Contract Documents.

B. Cable pulling plan showing cable feed and pulling winch locations, cable lengths, and calculated pulling tensions for each cable pull over 200 feet in length, or with a total of 180° or more of conduit bends.

C. Proposed cable lubricants and associated lubricating devices.

D. Proposed cable pulling equipment including cable grips, pulling rope, tensiometers, swivels, and cable pullers (winches).

E. Qualifications of all cable splicers proposed to be utilized for splicing work.

F. As-built lengths of all cable installed under this Contract.

G. Product Data: Shall consist of manufacturer's standard catalog cuts, descriptive literature and diagrams, in 8½ X 11-inch format, and in sufficient detail so as to clearly indicate compliance with all specified requirements and standards.

H. Manufacturer's Certification: Manufacturer shall submit signed certification confirming that they comply with the qualifications requirements and shall provide evidence of experience upon request.

I. Product Certification: Signed by manufacturer certifying that products comply with the specified specification requirements.

J. Report of Field Tests: Certified copies of field tests.

K. 24-inch long samples of the final assembled cables for First Article Inspection prior to release.

L. Submit catalog cuts for the following:

1. Wires and cables for each type and size.

2. Splice kit materials and installation procedures.

M. Submit certified shop test reports for wires and cables.

N. Submit field test results for wires and cables, including megger readings with the method used.

Materials:

Electrical components, devices, and accessories shall be listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

Cable type shall be MV105, and shall comply with UL 1072, AEIC CS 8, ICEA S-93-639, ICEA S-97-682 and ICEA S-94¬649. Conductor will be copper, and the conductor stranding will be compact round, concentric lay, Class B with the conductor strand interstices filled with impermeable compound. Conductor insulation will be cross-linked polyethylene or ethylene-propylene rubber with a voltage rating of 15 kV and an insulation thickness of 133 percent of the insulation level. Cable shielding will be copper tape helically applied over semiconducting insulation shield. The cable jacket will be sunlight-resistant PVC. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

Cables:

A. Okonite Company (The).
B. Kerite Co. (The); Hubbell Incorporated.
C. Pirelli Cables & Systems NA
D. Southwire.
E. Or approved equal.

Connectors and Splice Kits shall comply with IEEE 404 with the type as recommended by the cable or splicing kit manufacturer for the application. Splicing Products will be as recommended, in writing, by splicing kit manufacturer for specific sizes, ratings, and configurations of cable conductors. Include all components required for complete splice, with detailed instructions. Splices shall be suitable for submersible applications.

1. In-Line Splices shall be heat-shrink splicing kit of uniform cross-section, polymeric construction with outer heat-shrink jacket that covers the entire splice. The grounding mesh shall be internal to the outer jacket. Connectors shall be compression type.

Solid terminations for shielded cables shall comply with the following classes of IEEE 48. Insulation class is equivalent to that of cable. Include shield ground strap for shielded cable terminations be one of the following:

1. Class I Terminations: Modular type, furnished as a kit, with stress-relief tube; multiple, molded-silicone rubber, insulator modules; shield ground strap; and compression-type connector.
2. Class I Terminations: Heat-shrink type with heat-shrink inner stress control and outer nontracking tubes; multiple, molded, nontracking skirt modules; and compression-type connector.
3. Class I Terminations: Modular type, furnished as a kit, with stress-relief shield terminator; multiple-wet-process, porcelain, insulator modules; shield ground strap; and compression-type connector.

Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

Cable Splicing Products and Accessories:

A. Thomas & Betts Corporation/Elastimold, Part No. 655LR and K655LR power distribution connectors.
B. Tyco/Ray-Chem
C. Or approved equal.

600-A dead break connectors, “hammerhead style,” with no test point shall be used for 15 KV high voltage splices in manholes. 600-A dead break connectors shall be supplied by Tyco/Ray-Chem or approved equal. Separable insulated connectors shall comply with IEEE 386.

Provide tool set consisting of shotgun hot stick with energized terminal indicator, fault-indicator test tool, and carrying case.

Tape for first course on metal objects will be l G-mil- (250-micromcter-) thick, corrosion-protective, moisture-resistant, PVC pipe-wrapping tape. Arc-Proofing Tape to be used is fireproof tape, flexible, conformable, intumescent to 0.3 inch thick, compatible with cable jacket. Glass-cloth tape will be pressure-sensitive adhesive type, 1/2 inch wide.

Fault indicators are automatically reset fault indicator with inrush restraint feature, arranged to clamp to cable sheath and provide a display after a fault has occurred in cable. Instrument shall not be affected by heat, moisture, and corrosive conditions and shall be recommended by manufacturer for installation conditions.

Test and inspect cables according to ICEA S-97-682, ICEA S-94-649 before shipping. Test strand-filled cables for water-penetration resistance according to ICEA T-31-610, using a test pressure of 5 psig. Obtain cables and accessories through one source from a single manufacturer.

Construction Methods:

Install cables according to IEEE 576.

Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values. Where necessary, use manufacturer-approved pulling compound or lubricant that will not deteriorate conductor or insulation. Use pulling means, including fish tape, cable, rope, and basket-weave cable grips that will not damage cables and raceways. Do not use rope hitches for pulling attachment to cable. Before pulling cables in existing conduits, the Contractor shall review the conduit run via camera to verify that the conduit does not contain obstructions that could damage the cables. Obstructions shall be removed by thorough cleaning and then testing by the successful pulling of a brush and mandrel approved by the Engineer. The mandrel shall be not less than ¼ inch smaller than the inside nominal diameter of the conduit. The Contractor shall give the Engineer 24 hours notice prior to witness the cleaning and testing.

Install direct-buried cables on leveled and tamped bed of 3 inch thick, clean sand. Separate cables crossing other cables or piping by a minimum of 4 inches of tamped earth. Install permanent markers at ends of cable runs, changes in direction, and buried splices. Install "buried-cable" warning tape 12 inches above cables.

In manholes, handholes pull boxes, junction boxes, and cable vaults, train cables around walls by the longest route from entry to exit and support cables at intervals adequate to prevent sag.

Install cable splices at pull points and elsewhere as indicated; use standard kits. Install terminations at ends of conductors and seal cable ends with standard kits.

Install separable insulated-connector components as follows:

1. Protective Cap: At each terminal junction, with one on each terminal to which no feeder is indicated to be connected.
2. Portable Feed-Through Accessory: Three.
3. Standoff Insulator: Three.

Unless otherwise indicated, arc proof medium-voltage cable at locations not protected by conduit, cable tray, direct burial, or termination materials. In addition to arc proofing tape manufacturer's written instructions, apply arc proofing as follows:

1. Clean cable sheath.
2. Wrap metallic cable components with l0-mil (250-micromcter) pipe-wrapping tape.
3. Smooth surface contours with electrical insulation putty.
4. Apply arc-proofing tape in one half-lapped layer with coated side toward cable. Band arc-proofing tape with l-inch wide bands of half-lapped, adhesive, glass-cloth tape 2 inches o.c.

Seal around cables passing through fire-rated elements with penetration Firestopping.

Install fault indicators on each phase where indicated.

Ground shields of shielded cable at terminations, splices, and separable insulated connectors. Ground metal bodies of terminators, splices, cable and separable insulated-connector fittings, and hardware.

Identify cables according to NFPA 70 and ANSI A13.1 "Identification for Electrical Systems."

Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports: Perform the following field tests and inspections and prepare test reports:

1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters.
2. After installing medium-voltage cables and before electrical circuitry has been energized, test for compliance with requirements.

Remove and replace malfunctioning units and retest as specified above.

Method of Measurement:

The work covered by this section will be measured on a per “linear foot” basis, completely installed, including but not limited to materials, equipment, and labor for the installation, splicing, terminations and testing of the 15 KV Shielded Copper Cables.

Basis of Payment:

This work will be paid for at the contract unit price each for "500 KCMIL, 15 KV, Shielded Copper Cable."

Pay Item	**Pay Unit**
500 KCMIL, 15 KV Shielded Copper Cable	L.F.

ITEM #0202003A - EARTH EXCAVATION

Section 2.02 is supplemented and amended as follows:

Articles 2.02.01 – Description:

Add the following:

The New Haven Rail Yard is considered an area of environmental concern. For additional information refer to "Dewatering", "Handling Contaminated Groundwater", "Controlled Materials Handling", "Disposal of Controlled Materials", and "Management of Reusable Controlled Material" Specifications.

The Contractor shall be aware that there are designated archaeological sites within the New Haven Rail Yard. Excavations shall follow the requirements of Article 1.10.06 of the Standard Specification Form 816.

Article 2.02.04 – Method of Measurement:

Add the following:

Excavations beyond the payment limits will be considered "Unauthorized Excavation" and will not be paid for. Any soil generated by unauthorized excavations will be stockpiled separately and the Contractor shall assume the additional costs of environmental testing, stockpiling, off-site disposal of controlled and/or clean soils, and placement and compaction of suitable backfill.

Article 2.02.05 – Basis of Payment:

Add the following:

The cost for handling and disposal of contaminated excavated material will not be paid for under this Section, but will be paid for under the items, "Controlled Materials Handling" and "Disposal of Controlled Materials". The transport and placement of suitable reusable controlled materials will not be paid under this Section, but will be paid for under the item "Management of Reusable Controlled Material". Dewatering excavations will not be paid for under this Section but will be paid for under the Item "Dewatering".

ITEM #0203003A – STRUCTURE EXCAVATION – EARTH (COMPLETE)

This item shall conform to the requirements of Section 2.03 of the Standard Specifications, Form 816, supplemented and amended as follows:

Article 2.03.01 – Description:

Replace the first paragraph with the following:

With the exceptions noted below, structure excavation shall include the removal of all material of whatever nature, the removal of which is necessary for the construction of foundations of buildings, oil water separators, holding and storage tanks, retaining walls outside the earth excavation payment limits, catenary structures, poles, and other structures shown on the plans; the placing of all necessary fill with the exception of pervious structure backfill hereinafter specified; and the wasting of excavated material which is not required for backfilling or embankment, or which is unsuitable for that purpose.

Replace the second paragraph with the following:

This item shall not include dewatering; the design and construction of cofferdams and related environmental controls used in dewatering operations required for the execution of the work; the repair, reconstruction and removal of cofferdams and related environmental controls used in dewatering operations; or the removal of all obstructions necessary for the construction of cofferdams.

Add the following paragraph:

The New Haven Rail Yard is considered an area of environmental concern. For additional information refer to "Dewatering", "Handling Contaminated Groundwater", "Controlled Materials Handling", "Disposal of Controlled Materials", and "Management of Reusable Controlled Material" Specifications.

The Contractor shall be aware that there are designated archaeological sites within the yard. Excavations shall follow the requirements of Article 1.10.06 of the Standard Specification Form 816.

Article 2.03.04 – Method of Measurement:

Add the following:

Excavations beyond the payment limits will be considered "Unauthorized Excavation" and will not be paid for. Any soil generated by unauthorized excavations will be stockpiled separately and the contractor shall assume the additional costs of environmental testing, stockpiling, off-site disposal of controlled and/or clean soils, and placement and compaction of suitable backfill.

Article 2.03.05 – Basis of Payment:

Replace paragraph **(a)** with the following:

(a) Structure Excavation—Earth (complete), in whole or in part, which price shall include all materials, tools, and equipment; all labor necessary to complete the excavation in conformity with the requirements of the plans or as ordered by the Engineer; the preparation of foundations as described under Article 2.03.03; all necessary filling, except as otherwise provided in the Contract; and the removal of all surplus or unsuitable material resulting from the excavations.

Add the following*:*

The cost for handling and disposal of contaminated excavated material will not be paid for under this item, but will be paid for under the items "Controlled Materials Handling" and "Disposal of Controlled Materials". The transport and placement of suitable reusable controlled material will not be paid under this item, but will be paid for under the item "Management of Reusable Controlled Material".

Dewatering of structure excavations shall be paid for under the item "Dewatering".

Pay Item	Pay Unit
Structure Excavation – Earth (Complete)	C.Y.

ITEM #0205003A - TRENCH EXCAVATION 0' - 10' DEEP

ITEM #0205004A – ROCK IN TRENCH EXCAVATION 0' – 10' DEEP

ITEM #0205005A - TRENCH EXCAVATION 0' - 15' DEEP

ITEM #0205006A – ROCK IN TRENCH EXCAVATION 0' – 15' DEEP

Section 2.05 is supplemented and amended as follows:

Article 2.05.01 Description:

Add the following:

4) The construction of concrete duct banks.

The New Haven Rail Yard is considered an area of environmental concern. For additional information refer to "Dewatering", "Handling Contaminated Groundwater", "Controlled Materials Handling", "Disposal of Controlled Materials", and "Management of Reusable Controlled Material" Specifications.

On a daily basis, the Contractor will be allowed to backfill each utility trench with excavated material from the trench in place of reusable controlled material as shown on the plans or as directed by the Engineer. This material must only be placed above the seasonal high groundwater elevation (5.0'). The Contractor shall transport all surplus excavated material from the trench to the waste stockpile area at the end of each day. The untested material shall only be used as backfill in the trench from which it was excavated; it shall not be used as fill or wasted in any other location.

The Contractor shall be aware that there are designated archaeological sites within the New Haven Rail Yard. Excavations shall follow the requirements of Article 1.10.06 of the Standard Specification Form 816.

Classification:

(2) Rock in Trench:

Add the following:

The removal of concrete duct banks and the associated wires, conduits and reinforcing also is included in this item.

Article 2.05.03 – Construction Methods:

Add the following:

Test pits shall be dug at the locations shown on the plans or as ordered by the Engineer. If called for, the existing surface shall be restored and paid under the appropriate items.

Article 2.05.04 Method of Measurements:

Add the following:

For the installation of concrete duct banks horizontal payment lines shall be vertical and shall be the width to which the material is actually removed, except that in no case, even though the actual excavation is wider, shall the width between payment lines be more than the following:

(a) 2 feet greater than the outside width of the duct bank for duct banks with widths less than 30 inches.
(b) 3 feet greater than the outside width of the duct bank for duct banks with widths that are 30 inches or greater.

Vertical payment limits shall be similar to as described for pipe installations.

Excavations beyond the payment limits will be considered "Unauthorized Excavation" and will not be paid for. Any soil generated by unauthorized excavations will be stockpiled separately and the contractor shall assume the additional costs of environmental testing, stockpiling, off-site disposal of controlled and/or clean soils, and placement and compaction of suitable backfill.

Test pit excavation:

Horizontal: Excavation shall be measured 2' outside the neat lines of the object to be found. For pipe it shall be measured transversely 2' plus the outside diameter of the pipe and longitudinally along the pipe it shall be measured 5 times the outside diameter of the pipe.

Vertically: It shall be measured from ground surface to 1' below the object to be located.

Article 2.05.05 Basis of Payment:

Delete the last sentence of the 11th paragraph and replace it with the following:

When it becomes necessary, in the opinion of the Engineer, to install temporary earth retaining system for the support of existing facilities, pavement, utilities, or for other constraints, such installation shall be paid for under item "Temporary Earth Retaining System".

Add the following:

The disposal of materials excavated under this item determined to be non-contaminated shall be included in the Trench Excavation item.

The cost for handling and disposal of contaminated excavated material will not be paid for under this Section, but will be paid for under the items, “Controlled Materials Handling” and “Disposal of Controlled Materials” Specifications. The transport and placement of suitable reusable controlled material will not be paid under this Section, but will be paid for under the item “Management of Reusable Controlled Material”. Dewatering excavations will not be paid for under this Section but will be paid for under the Item “Dewatering”.

Included in the contract unit price for Trench Excavation shall be the excavation for test pits.

Backfilling of the Trench shall be paid under the appropriate items “Management of Reusable Controlled Material”, or “Compacted Granular Fill”

Pay Item	Pay Unit
Trench Excavation 0’ – 10’ Deep	C.Y.
Rock in Trench Excavation 0’ – 10’ Deep	C. Y.
Trench Excavation 0’ – 15’ Deep	C.Y.
Rock in Trench Excavation 0’ – 15’ Deep	C. Y.

ITEM #0216012A - CONTROLLED LOW STRENGTH MATERIAL

Description: Controlled Low Strength Material (CLSM) is a self consolidating, rigid setting material to be used in backfills, fills, structural fills and elsewhere as indicated on the plans, or as directed by the Engineer. The flow and set time characteristics of CLSM shall be designed to meet the specific job conditions. All CLSM material covered by this specification shall be designed to be hand excavatable at any time after placement. It shall be composed of a mixture of portland cement, aggregate, and water with the option of using fly ash, slag cement, air-entraining agents, and other approved admixtures.

Materials: All materials utilized in the CLSM mix design shall be in accordance with the applicable requirements of Article M.03.01

Composition: The composition of the CLSM shall be in accordance with the requirements set forth in Article M.03.01-General Composition of Concrete Mixes, as well as the applicable sections of ACI 229R. The Contractor shall submit each proposed mix design, with all supporting data, to the Engineer for review and approval at least two weeks prior to its use.

The setting time of CLSM materials shall be designed so as to achieve the strength necessary to comply with the time constraints called for under the Maintenance and Protection of Traffic requirements of the project specifications. The use of chloride accelerators is not permitted.

The minimum compressive strength of the CLSM material shall be 30 pounds per square inch (psi) and the maximum compressive strength of the CLSM shall be 150 pounds per square inch (psi) when tested in accordance with ASTM D4832 after 56 days.

The CLSM mix design shall utilize a nominal maximum size of No. 8 aggregate as specified in M.01.01.

CLSM mixes shall have a minimum of 20% entrained air when tested in accordance with AASHTO T152.

Construction Methods: CLSM shall only be placed when the ambient temperature is at least 32° F and rising. CLSM material shall be deposited within 2 hours of initial mixing.

CLSM may be placed by chutes, conveyors, buckets or pumps depending upon the application and accessibility of the site. Should voids or cavities remain after the placement of the CLSM, the Contractor shall modify the placement method or flow characteristics of the CLSM. Voids or cavities which have not been filled properly shall be corrected as directed by the Engineer and at the Contractor's expense.

Method of Measurement: This work will be measured for payment by the actual number of cubic yards of "Controlled Low Strength Material installed and accepted within the pay limits shown on the contract plans or as directed by the Engineer.

Basis of Payment: This work will be paid at the contract unit price per cubic yard "Controlled Low Strength Material," which price shall include all materials, equipment, tools and labor incidental thereto.

ITEM #0504010A - RAILROAD TRACK WORK

ITEM#0503471A - TURNOUT INSTALLATION

ITEM #0503004A - LIFT AND LINE EXISTING TRACK

Description:

This work shall consist of installing timber ties, rail, turnouts, tie plates, Pandrol clips or spikes and rail anchors, and all other materials necessary to construct the railroad tracks to the lines and grades as shown on the plans or as directed by the Engineer. Materials not furnished by MNR shall be provided by the Contractor.

Materials:

All materials necessary to construct the track structure shall conform to the American Railway Engineering and Maintenance of Way Association's Manual for Railway Engineering (AREMA) and the Metro-North Railroad MW-4.

1. Owner-Furnished Materials – 136 RE Head Hardened Rail and Turnouts will be furnished by MNR for installation by the Contractor. Rail, with bolt holes pre-drilled in one end only, will be delivered to the rail yard by MNR in 80 foot long strings and the Contractor must move the rail to the final installation location. Turnouts will be stockpiled within the rail yard and must be relocated to the installation site by the Contractor. Solar-Powered Switch Machines will be furnished and installed by MNR.

2. Contractor Furnished Materials - Per AREMA and MNR MW4 and the following:

    a. Crossties: New 7" x 9" x 8'-6" treated hardwood crossties per AREMA, MNR MW-4 and Metro-North Commuter Railroad Specifications for Cross Ties & Bracket Ties, Rev. 6, 12-21-10.

    b. Switch Timbers: New 7" x 9" in lengths of 10', 11', 12', 13', 14', 15', 16', 17' and 21' per AREMA and MNR MW-4 as required for turnouts shown in the Drawings.

    c. Tie Plates: Canted double shoulder for 6-inch base rail, new or relay, not less than 12-inches in length. For use in existing track only.

    d. Spikes: New, 5/8" x 6" high carbon steel track spikes per AREMA. For use in existing track only.

    e. Joint Bars: New, produced in matched pairs, standard six hole punching per AREMA Chapter 4 Specifications for Quenched Carbon Steel Joint Bars,

Microalloyed Joint Bars and Forged Compromise Joints, compatible with the rail provided by MNR and the existing rail at the connection points.

f. Compromise Joints: New, six hole forged steel compromise joints per AREMA.

g. Bolt Assemblies: New, proper size for the rail and joint bars provided, per AREMA and ASTM standards. Standard joint bar bolts and nuts shall be heat treated carbon steel as per ASTM A183 Grade 1, with sulfur not over 0.06%. Washers shall be in accordance with AREMA and ASTM F-436.

h. Rail Anchors: New or fit re-formed per AREMA. For use in existing track only.

i. Pandrol Rail Fastening Assemblies - All newly constructed track is based upon Pandrol brand rail fastening assemblies as follows:

1) Tie Plates – New 1:40 canted double shoulder design, not less than 16 inches in length, for new or fit second hand six-inch base rail with round holes for screw spikes. Plates can be rolled, punched, machined or forged. Rolled plates shall be in accordance with ASTM-A67, Steel Tie Plates, Low-Carbon and High-Carbon Hot worked.

2) Elastic rail clips – New, Pandrol design e-2055 or PR601A or accepted equal. For joint bars provide either Pandrol "J" model clips or the Pandrol "C" clip assembly or approved alternative.

3) Screw Spikes / Coach Screws - 15/16" diameter by 6" length.

Construction Methods:

Track installation shall comply with provisions of Specifications, Standards, and recommended practices of the most recent edition, and addenda thereto, of the AREMA Manual and the Metro-North MW-4.

The existing grade shall be leveled and compacted following the clearing and grubbing operation. Subballast and ballast shall be provided and installed in accordance with the specifications and as shown on the plans or as directed by the Engineer.

MNR shall deliver rail in 80 foot long strings to the rail yard and turnouts will be stockpiled within the rail yard ready for relocation, assembly and installation by the Contractor. Installation of ties, rail and turnouts shall proceed in a sequence approved by the Engineer to yield as little impact as possible upon yard operations.

Following final surfacing, all rail will be set to the neutral temperature specified in the MNR MW-4.

Installation and adjustment of switch machines will be performed by MNR forces.

Track Criteria

1. Gage: Standard gage of track shall be 4 feet 8-1/2 inches.

    a. Gage shall be measured with a standard track gage. It shall be measured at right angles to rails between points 5/8 inch below top of rails. The Contractor's track gages shall be checked at frequent intervals for accuracy.

2. Alignment, Grade, Super Elevation, Track Centers and Cross Level:
   Definitions are as follows:

    a. Alignment: Horizontal location of track as described by curves and tangents. (Alignment shall be as established on the Drawings.)

    b. Grade: Ratio of rise, or fall, of the grade line to its length. (Grade shall be as established by the profiles shown on the Drawings.)

    c. Track centers: The distance between center lines of adjacent tracks, measured in a horizontal plane and at right angles to one of the tracks.

    d. Cross Level: The difference in elevation of the tops of opposing rail of a track measured in a horizontal plane at right angles to the alignment.

3. Tolerances: Deviation from established gage, cross level, profile grade and horizontal alignment shall not exceed the criteria specified.

	TRACK SURFACE AND ALIGNMENT	TOLERANCES
a.	Deviation from a true gage of 4 feet – 8 ½ inches, measured at a plane 5/8 inch below top of rail on the inside face may not exceed	1/8"
b.	Deviation from uniform profile on either rail at the midordinate of a 62 foot chord may not exceed	1/4"
c.	Deviation from zero cross level at any two points less than 62 feet apart on tangents or curves may not exceed	1/4"
d.	Deviation from uniform alignment between any two point less than 62 feet apart on tangent and curved track may not exceed	1/4"

General Track Installation Procedures

1. Ballast which is more than 4 inches below the final bottom of crosstie elevation will be known as "bottom ballast" and shall be placed and compacted prior to the construction of

track. Ballast above that elevation shall be placed subsequent to the construction of skeleton track on the prepared bottom ballast.

2. Distribute and compact subballast and bottom ballast uniformly in layers not exceeding a compacted depth of 4 inches for each lift as per the cross sections in the Contract Drawings.

3. Thoroughly compact subballast and ballast until the stones are firmly interlocked and the surface is true and unyielding. Compact each lift with not less than four passes of a roller or a vibratory compactor subject to the following requirements:

    a. Compact by rolling using either a self-propelled roller of such weight that will provide compression of not less than 350 lb per linear inch of tread or roller.

    b. Compact by vibration using vibration compactors of either the roller or pad type. Dynamic force for either type shall be not less than 20,000 lb and the frequency range shall be 1100 to 1500 vpm.

    c. The compacting equipment selected by the Contractor shall be approved in advance by the Engineer.

4. Place timber ties normal to the centerline of track spaced at nineteen and one half inches on center so that the heartwood of the ties is down and the bottom surface of the ties have uniform bearing against the ballast. The ends of 8'-6" ties shall be brought to a uniform line, 18 ½" from the edge of the base of rail on the line side. The line side shall be the northern side of the track in tangent and curved track and the straight side of each turnout. When placing ties care shall be taken not to damage ties with picks and spiking hammers. Tie tongs, lining bars, or other suitable tools or tie spacing equipment shall be used.

5. Install tie plates on the longitudinal centerline of each tie and place square to the centerline of the rail so that the outside shoulder of the plate bears fully against the rail base. Place plate with the downward cant toward the center of the track. Where using conventional tie plates and spikes, (in existing track only) rail shall be spiked with a minimum of two rail holding spikes and one plate holding spike per tie plate. Where using Pandrol plates, (to be used in construction of all new track) place two screw spikes on the gauge side of the rail and one screw spike on the field side. Holes must be pre-bored in the ties for the screw spikes and a minimum of three plate holding screw spikes per plate must be installed.

6. Crosstie Replacement: Replace defective crossties in existing tracks on approaches to new turnouts as directed by the Engineer. The Engineer will designate a maximum of 200 ties to be replaced concurrent with turnout installation.

7. Rail and Joint Bars:
    a. Rail joints must be staggered by a minimum of 36" and preferably configured as suspended joints so as to facilitate future thermite welding by others. When drilling bolt holes in the blank rail end, omit the end hole on each rail end and bolt-up six hole bars using only four bolt assemblies, leaving the joint in a condition suitable for future thermite welding by others.
    b. Outside of turnouts, the minimum length of rail allowed is 20 feet.
    c. Compromise joint bars must be fabricated and installed in such a manner that any horizontal mismatch of rail ends is less than 1/16" and a vertical mismatch that is no greater than 1/16". The rail on existing Tracks 29 and 38 and the Coal Bridge Track at the interface with new track and turnout installation must be investigated by the Contractor in advance of ordering compromise bars. The new rail to be supplied by MNR will be 136 RE.
    d. If CWR strings of greater than 78 feet in length are installed when the air temperature is below 90 degrees Fahrenheit, rail neutral temperature must be adjusted in accordance with procedures in the AREMA Manual and Metro-North's MW-4.
    e. When cutting rails, cuts must be clean and square using a rail saw or abrasive cutting disc only. Bolt holes shall be drilled. Do not cut rails with a torch.
    f. All joints assembled by the Contractor shall be bolted, but configured for future rail welding. Rail welding will be performed by others subsequent to the Contract.

8. Rail Anchoring:
    a. Anchoring shall not proceed until the track has been sufficiently ballasted to prevent tie or track movement due to thermal expansion or contraction and until the track has been initially raised, tamped and aligned. Anchoring shall not proceed if the ambient temperature is less than 20 degree F. Anchors shall be applied flush to the side of the tie, on each rail with every other tie fully box-anchored. Anchors shall be omitted from a point four ties in advance of and behind switch points and at all locations where it is not possible to install anchors on each rail. For strings of welded rail 78 feet in length or greater, a minimum of 10 consecutive ties on each side of the rail joint at the end of the string shall be fully box-anchored excepting the conditions in the previous sentence.
    b. Omit rail anchors on tracks and turnout constructed with Pandrol elastic rail fastenings.
9. Surface and align track by methods which will prevent undue bending of the rail, straining of joints or damaging rail fastening assemblies, and only after the cribs have been filled with ballast. No surfacing or aligning work shall be performed on track when the ambient rail temperature is greater than the temperature of the rail at the time it was anchored, nor less than 20 degrees Fahrenheit. Rail temperature shall be measured using a rail thermometer as specified in the current AREMA Manual, Chapter 5 by placing the rail thermometer on the shaded side of the rail base and leaving it in place for a minimum of five minutes or until there is no change in its reading.

10. When tamping ties, the ballast shall be thoroughly compacted under both sides of the tie from a point 15 inches inside of the rails to the ends of the tie. Do not tamp at the center of the tie outside of the limits indicated.

11. Final surfacing and aligning of the track and turnouts shall be in accordance with the geometries listed in the Contract Drawings. The final raise shall consist of a lift of no greater than 2 inches to bring the track surface to the final grade indicated on the Contract Drawings. Where tracks constructed by this contract connect to existing tracks, run out the surfacing into the adjoining tracks a distance as indicated by MNR's MW-4.

12. After the final surfacing and aligning of the track and turnouts, ballast shall be adjusted so that all cribs, excepting those beneath switch rails, are full. Leave the cribs open beneath switch rails and switch rods so that there is a minimum of 5 inches of clear space beneath them. Dress the ballast shoulder so that it extends beyond the ends of the ties of at least one foot horizontally in the plane of the top of tie at which point the shoulder may drop at a maximum rate of 2 horizontal to 1 vertical. Excess ballast shall not be left on top of the ties or timbers and shall not be allowed in flangeways or between stock rails and switch points. Final surfacing and alignment shall be within the tolerances listed in this specification.

13. Turnouts shall be installed in the same general manner as listed above in accordance with the geometric criteria in the Contract Documents. Survey is required to layout the Point of Switch, PITO and Point of Frog prior to installation and to be confirmed after completion of turnout installation. MNR will furnish and install switch machines and make final switch adjustments.

14. In order to determine the acceptability of the completed track and turnouts, the Engineer will verify that the track structure was constructed according to the Contract Documents. The Contractor shall submit appropriate scale reproducible final As built survey drawings of the trackwork for this verification. The As Built survey drawings shall indicate points on each rail at 50 foot stations as well as all points of curvature including tangent to curve, compound curve, curve to tangent points, points of vertical curves and tangents, start and end points, and all points of switch, PITO's and frog points. Drawings shall conform to the Connecticut General Statues, Section 20-300b with a Horizontal Accuracy of A-1 and a Vertical Accuracy of V-2. Once verified, the Engineer will schedule MNR to make a final inspection to establish that the track and turnout construction is within the tolerances specified herein. The Contractor shall correct track deviations, as disclosed by the inspection, which exceed tolerances specified herein at no additional cost. The Contractor shall notify the Engineer two weeks in advance of the anticipated date(s) when the track will be ready for MNR inspections.

Method of Measurement:

Railroad Track Work will be measured for payment by the actual number of lineal feet measured along the centerline of track, installed and accepted. One track consists of two rails, connecting

ties, bumping post and all appurtenances. Where rail ends are staggered, the average of the two rail ends shall be used as the point of measurement. Track installed within the Car Storage Areas will be included in this measurement.

Turnouts will be measured for payment by the count of turnouts installed. One turnout includes switch ties, head block timbers, frog, switch points and stock rails, closure rails, and all throw rods. Each turnout unit shall be considered as beginning at the Number Zero tie ahead of the point of switch and extending to the Last Long Timber beyond the frog. Other track outside of that zone will be measured by the linear foot as indicated above.

Lifting and Lining will be measured for payment by the linear footage of existing track brought to final alignment. The allotment of 200 ties to be installed as directed by the Engineer concurrent with turnout installation shall not be measured for payment, but shall be considered as incidental to the lifting and lining of the tracks outside of the turnouts.

Basis of Payment:

This work will be paid for at the contract unit price per "Lineal Feet" for Railroad Track Work, "Each" for Turnout Installation and "Lineal Feet" for Lift and Line Existing Track, complete in place, which price shall include all material, equipment, tools, and labor incidental thereto.

The cost for excavation below the finished grade of the track, backfilling, subballast, ballast and disposal of surplus material will not be paid under this section, but will be paid for under their respective contract items.

Pay Item	Pay Unit
Railroad Track Work	L.F.
Turnout Installation	EA.
Lift and Line Existing Track	L.F.

ITEM # 0507162A - TYPE "C-L" CATCH BASIN, DOUBLE GRATE TYPE II WITH 4’ SUMP OVER 10’ DEEP

ITEM #0507237A – SPECIAL ROUND TYPE “C-L” CATCH BASIN OVER 10’ DEEP

ITEM #0507238A – SPECIAL ROUND TYPE “C-L” CATCH BASIN

ITEM # 0507484A - TYPE "C-L" CATCH BASIN, DOUBLE GRATE TYPE II (4’ SUMP)

ITEM # 0507685A – MANHOLE - 6' DIAMETER

All the above items shall conform to the requirements of Article 5.07 of the Standard Specifications supplemented as follows:

Article 5.07.01 Description:

Add the following:

Catch basins and manholes shall be precast and watertight. Manholes and catch basins shall have pipe connectors. All joints shall have a watertight sealant. Manholes and catch basins shall be visually inspected for leakage. Manholes and catch basins shall receive a factory-applied waterproofing coating as specified herein.

Special Round Catch Basins shall be Double Grate Type II with 4” Sump.

Article 5.07.02 Materials:

Add the following:

Compacted granular fill: shall conform to the requirements of Section 2.14.

Concrete for anti-flotation purposes shall be Class "A".

Frame and Cover: The cover shall have lettering "STORM SEWER" cast into it.

Pipe Connectors with Flexible Annular Space Filler:

1. Conform to ASTM C923.
2. Cast in place with stainless steel bands.

3. Band and clamp non-magnetic Series 304 stainless steel.
4. Nitrile and PVC cavity O-ring.
5. Do not furnish connectors using castings and bolts with non-resilient bearings.

Waterproof Coating System: The outside surface of all catch basins and manholes shall be coated with a waterproof protective membrane. Membrane material shall be a single component rubber reinforced asphalt which forms a highly elastomeric waterproofing coating. Membrane shall be applied to precast concrete using a smooth edge trowel at the rate of 4 gallons per 100 square feet to achieve a dry film thickness of 40 mils. Joints and cracks shall be filled and reinforced per manufacturer's recommendations. Typical properties of cured materials shall be as follows:

Property	**Value**
Tensile Strength per ASTM D412	400 psi
Elongation, per ASTM D412	700%
Hardness Shore A per ASTM D2240	55
Permeance	0.25 metric perms

Joints: Joints between precast catch basin and manhole concrete sections shall have rubber gaskets in compliance with ASTM C443 or receive a 1/2-inch bead of single component hydrophilic sealant. Physical properties in the hardened state shall be as follows:

Physical Properties	**Test Method**	**Min. Value**
Hardness (Shore)	ASTM D2240	20
Tensile Strength	ASTM D412	350 psi
% Elongation at Ultimate Failure	ASTM D412	700%
% Volume Exp.		180%
Specific Gravity		1.28 ±0.15
Polymerized		Yes

Submittals:

Precast catch basins and manholes shall be designed for Cooper E-80 loadings. All structures shall be designed to accommodate loading applied at a distance of 4'-3" from the centerline of track. Structures shall be designed by a Connecticut Licensed Professional Engineer. Contractor shall submit stamped shop drawings and calculations to the Engineer for approval.

Article 5.07.03 Construction Methods:

Add the following:

Install manholes and catch basins on a 12 inch thick layer of No 6 Crushed Stone base.

Sealant and pipe connectors shall be installed per manufacturer's instructions to assure a watertight seal.

All exterior surfaces of the precast manholes and catch basins (excluding tops of catch basins) shall be given an application of waterproofing at the factory. Apply per manufacturer's recommendation. Additional waterproofing material shall be supplied to the site to be used as touch up as directed by the Engineer.

Place precast concrete sections in compliance with ASTM C891. Provide either ASTM C443 rubber joints gaskets or hydrophilic sealant at joints between sections.

Manhole and catch basins shall be visually inspected for leakage. All leaks shall be sealed.

Backfill around catch basins and manholes shall not be pervious structure material, but shall be suitable backfill, reusable controlled material or as called for on the plans or as directed by the Engineer.

In paved areas, all catch basin tops shall be set flush with the finished surface. In ballasted areas, all catch basin tops shall be set 3 inches above the finished surface.

Article 5.07.05 Basis of Payment:

Add the following:

Included in the unit price shall be the No 6 Crushed Stone bedding material, pipe connectors, joint sealants, rubber gaskets and damp-proofing (including additional material). Also included in the unit price shall be testing of the manholes and catch basins, installation and material costs for the anti-flotation concrete.

ITEM #0603169A - PROGRESS PHOTOGRAPHS

Description:

Under this item, the Contractor shall engage a qualified commercial photographer to take photographs during construction. The photographer shall be a firm or an individual of established reputation that has been regularly engaged as a professional photographer for not less than 3 years.

At the Preconstruction Meeting, submit to the Designer for approval the name of the photographer whom will be responsible for taking the photographs during construction.

Submit photos of each view within seven (7) calendar days of taking photographs. Four photographic sets of photos shall be submitted. ALL photos shall be submitted in IBM-PC compatible digital format on compact disc (CD). Other than the photo thumbnail index and the photo key plan required for submission with each CD, no other hardcopy photos shall be required for the project. One (1) set of photos (on CD) of each submittal shall be sent directly to each of the following offices:

Manager of State Design, Office of Facilities Design, Connecticut Department of Transportation, 2800 Berlin Turnpike, P.O. Box 317546, Newington, CT 06131-7546, Attention: Trans. Principal Engineer (Facilities Design), Room 3405NW.

District 1A Construction, Connecticut Department of Transportation, Project Chief Inspector's Construction Trailer.

Bureau of Public Transportation, Office of Rail, Connecticut Department of Transportation, 2800 Berlin Turnpike, P.O. Box 317546, Newington, CT 06131-7546, Attention: Mr. Mark D. Neri, Room 1329NW.

PB Americas, Inc., 148 Eastern Boulevard, Suite 200, Glastonbury, CT 06033, Attention: Mr. Glen Hayden.

Shaw Environmental & Infrastructure Group, 100 Technology Center Drive, Stoughton, MA 02072, Attention: Mr. John Finik.

Each CD and CD jewel case shall be labeled with the name of the project, State project number, name of the Contractor, date of submission, and name and address of the photographer.

Materials:

Provide digital images in IBM-PC compatible JPEG format, with uncompressed (open) image size equal to or greater than the following dimensions: Pixel Dimensions = 1596 x 2000;

Resolution = 200 pixels/inch. JPEG compression for each image shall equal "Quality 7" (High). Images shall be color (RGB mode).

Digital Cameras used for the purpose of creating the above noted image files shall have a minimum sensor size of 3.3 million pixels.

Image files shall be named and a photo thumbnail index created with the following file naming convention: *Project number_date of submission_photo number.jpg*

For example: If the first set of photos on CD for project number 300-0139, is submitted on 06/18/07, the first photo of the submission shall be file named: 3000139_061807_1.jpg and the tenth photo of the set shall be file named: 3000139_061807_l0.jpg. In the second set of photos on CD, submitted 06/25/07, the first photo of the set shall be file named: 3000139_062507_1.jpg

A hardcopy "Photo Thumbnail" index shall be provided with each CD submission. The photo thumbnails shall be printed on 8 1/2"x 11" "glossy photo quality" ink jet paper with a minimum 720 dot-per-inch ink jet printer. The thumbnail images shall be a minimum 200 x 250 pixels at 200 pixel per inch resolution. The file names shall be located under each image. The thumbnail images shall be arranged so that they can all be contained on a single 8 1/2-in by 11-in inkjet print. *For example*, 35 images would be arranged in five (5) columns and seven (7) rows. The CD shall also contain the digital file of the photo thumbnail index in jpeg format. The file shall share the same format as the above noted photo file format but the word "index" shall be placed in the location of the photo number. *For example*: 3000139_061807_index1.jpg

Photos shall be numbered and referenced by number on a “Photo Key Plan.” A hardcopy of the photo key plan shall be provided with each CD submission. The photo key plan shall be printed on 8 1/2"x 11" "glossy photo quality" ink jet paper with a minimum 720 dot-per-inch ink jet printer. The key plan shall be made on digital images of the projects overall site plans and/or the overall building plans, as appropriate for the photos being submitted, and shall include an arrow pointing in the direction of the photo with the associated photo number. The CD shall also contain the digital file of the photo key plan in jpeg format. The file shall share the same format as the above noted photo file format but the word "key plan" shall be placed in the location of the photo number. *For example*: 3000139_061807_keyplan1.jpg.

In lieu of using a digital camera to provide the above noted image files, standard 35 mm cameras and 35 mm color negative film may be used to take the images, and the images may then be captured as a digital file through the use of a designated 35mm film scanner. The 35 mm scanner must have the following minimum specifications: 2700 dot per inch optical resolution; 3.4 Dmax; 36 bit color depth. The use of flatbed scanners shall not be permitted for this purpose.

Project progress photos shall be submitted as digital files on write-once CD-ROM in a jewel case on a monthly basis. All subsequent CD submissions shall include the image files of the previous submissions and an updated hardcopy of the photo thumbnail index that contains all current and previous photos.

Construction Methods:

Where used herein, one set of photographs will be defined as 50 photographs.

Before starting construction, take one set of color photographs of the site and surrounding properties from different points of view as selected by the Engineer. Take photographs to show existing conditions to the property before starting Work. Take photographs of existing buildings either on or adjoining the property in sufficient detail to record accurately the physical conditions at the start of construction.

Take one set of color photographs at no greater than monthly intervals, coinciding as closely as possible with the completion of a major construction phase. The photographer shall select the vantage points for each shot each month to best show the status of construction and progress since the last photographs were taken. Prior to taking any photographs, review the proposed vantage points for each shot with the Engineer. Photographs are for a record of the progress of work. Therefore, they shall be taken at a maximum interval of one month, whether or not they show any completion of work performed during the preceding month.
Take one set of color photographs upon notification by the Engineer of Final inspection of the Project. Prior to taking any photographs, review the proposed vantage points for each shot with the Engineer. Take photographs from opposing views of the site in an effort to display various characteristics of the new construction.

Method of Measurement:

This work will be measured for payment by the number of photographic sets submitted to the Engineer. "Each" photographic set shall be defined as 50 photographs. For purposes of bidding, the pay unit for a photographic set shall be "Each."

Basis of Payment:

This work will be paid for at the Contract unit price each for "Progress Photographs" which price shall include all material, equipment, and labor incidental thereto. Where any submission's image files do not conform to the requirements herein, the Contractor shall not receive any payment for the item.

Pay item	Pay Unit
Progress Photographs	EA.

ITEM # 0651380A - 36" POLYVINYL CHLORIDE PIPE

ITEM # 0651743A - 6" POLYVINYL CHLORIDE PIPE

ITEM # 0651746A - 12" POLYVINYL CHLORIDE PIPE

ITEM # 0651757A - 18" POLYVINYL CHLORIDE PIPE

ITEM # 0651761A - 24” POLYVINYL CHLORIDE PIPE

ITEM # 0651762A - 30” P.V.C. PIPE

These items shall conform to the requirements of Article 6.51 of the Standard Specifications supplemented and amended as follows:

Article 6.51.01 Description:

Add the following:

This item shall also consist of furnishing and installing storm drain pipes of various sizes, types and slopes at the locations and to the grades or general requirements shown on the contract drawings or as directed by the Engineer.

This work shall also include the satisfactory testing of the gravity pipe.

Included in this item shall be the air testing of pipe.

Article 6.51.02 Materials:

Add the following:

Polyvinyl Chloride Pipe (PVC) and fittings shall conform to one of the following:

1. ASTM D3034: sizes up to 15 inches diameter
2. ASTM F679 – Pipe shall be solid wall pipe with a minimum stiffness of 46 lbf/in: sizes 18 to 36 inches diameter
3. ASTM F949 for corrugated PVC, smooth interior: sizes up to 36 inches diameter
4. AWWA C905: sizes up to 48 inches diameter
5. ASTM F1803 – Pipe shall be closed profile pipe with a minimum stiffness of 46 lbf/in: sizes 18 to 60 inches diameter. Closed profile pipe shall have a minimum

stiffness of 46 psi for 18 inch to 27 inch diameter PVC pipe and minimum stiffness of 50 psi for 30 inch to 60 inch diameter PVC pipe.

The pipe shall have pipe diameter to wall thickness ratio (SDR) of a maximum of 35.

Pipe joints shall be sealed by high quality factory installed nitrile O-ring gaskets and shall conform to the requirements of ASTM F477.

Joints shall be the bell and spigot type subject to the approval of the Engineer. Joints shall be sealed with a nitrile "0" ring gasket, approved by the Engineer, and shall be of a composition and texture which is resistant to industrial wastes including oils and ground water, and which will endure permanently under the conditions likely to be imposed by this use. The joints shall conform to ASTM D3212.

The tensile strength shall be at least 1300 psi. The elongation at rupture shall be such that 2 inch gauge marks shall stretch to not less than 10 inch. Hardness shall be between 40 and 50, as measured with a Shore Durometer. The compression set (constant deflection) shall not exceed 25 percent of the original deflection.

The tensile strength after accelerated aging shall be not less than 80 percent of the original strength. The joint, when assembled, must be able to withstand a hydraulic pressure internally of at least 25 psi.

Fittings: Wyes, Tees, Bends and adapters, and any other fittings required by the Engineer shall be provided. Plans for such fittings showing cross sectional views with dimensions shall be provided, and the Engineer prior to their use shall approve such plans and fittings. The materials used in the manufacture of fittings shall conform with the requirements for the Pipe with which they shall be used and any variation of such requirements shall be subject to approval of the Engineer.

Testing: Pipe shall be tested when requested by the Engineer, and all sizes of pipe so designated shall be tested as follows:

Pipe shall be tested in accordance with ASTM D-2412 Standard Method of Test for External Loading Properties of Plastic Pipe by Parallel-Plate Loading.

Marking: Pipe shall be marked along the outside of the barrel in bold style type and shall indicate the manufacturer's name, pipe size, PVC compound used, i.e., PVC Type 1 Grade 1 and the ASTM material specification for the PVC compound used, i.e., ASTM D3034.

Workmanship: The pipe and fittings shall be homogeneous throughout and free from visible cracks, holes, foreign inclusions or other injurious defects. The pipe shall be as uniform as commercially practical in color, opacity, density and other physical properties.

Waterstops: The manufacturer shall provide waterstops, acceptable to the Engineer, which shall be applied to the outside of plastic pipe when the pipe is to be enclosed in any structure

where concrete or mortar is used which will prevent leakage along the outer wall of the barrel of the pipe.

Waterstops within each trench greater than 100' in length between structures are required and shall be Concrete Class "C" with no reinforcing.

Flexible Couplings: As required shall be manufactured by Fernco, Inc. Davison, Michigan or approved equal.

Article 6.51.03 Construction Methods:

Add the following:

Pipe Installation: Storm drain pipe shall be of the sizes, type, materials, etc., indicated by contract documents; all pipes shall be laid, supported, jointed, tested and backfilled as indicated or required for the particular job, location, or condition by drawings or other contract documents. All pipes when in place shall be precisely true to the line and grade indicated therefore by the Engineer, sound, well laid, jointed and bedded and free from defects. Any pipe discovered to be defective after having been laid shall be removed and replaced by a sound and satisfactory piece. All pipes shall be installed with a laser to assure close conformance to required grades.

All pipe shall be stored at the site until installation in a manner acceptable to the Engineer which will keep the pipe at ambient outdoor temperatures. Temporary shading shall be provided as required to meet this requirement. Simply covering the pipe or structures that allow temperature build up when exposed to direct sunlight will not be permitted.

Installation of PVC Pipe shall be in accordance with ASTM Specification D2321 and the following.

All pipes shall be installed per manufacturer's installation instructions.

Geotextile: The Contractor shall furnish and install Geotextile as called for in the contract drawings and in accordance with Article 7.55.03.

Bedding: Pipes shall be bedded in No. 6 Crushed Stone or as otherwise directed by the Engineer in accordance with the contract drawings and as described in of these specifications. Suitable bell holes shall be provided, so that after placement, only the barrel of the pipe receives bearing pressure from the supporting material.

All pipe and fittings shall be cleared of all debris, dirt, etc., before being installed and shall be kept clean until accepted in the completed work.

Pipe Straightness: No single piece of pipe shall be installed unless it is found to be generally straight. Such pipe shall have a maximum ordinate as measured from the concave side of the pipe not to exceed 1/16 inches per foot of length. If the deviation from straightness exceeds this requirement then the particular piece of pipe shall be rejected for use until it can comply with this provision.

Before any joint is made, the previously installed unit shall be checked to assure that a close joint with the adjoining unit has been maintained and that the inverts are matched and conform to the required grade. The pipe shall not be driven down to the required grade by striking it with a shovel handle, timber or other unyielding object.

All joint surfaces shall be cleaned. Immediately before jointing the pipe, the bell or groove shall be lubricated in accordance with the manufacturer's recommendation. Each pipe unit shall then be carefully pushed into place without damage to pipe or gasket. Suitable devices shall be used to force the pipe units together so that they will fit with a minimum open recess inside and outside and have tightly sealed joints. Care shall be taken not to use such force as to wedge apart and split the bell or groove ends.

Details of gasket installation and joint assembly shall follow the directions of the manufacturers of the joint material and of the pipe, all subject to review by the Engineer. The resulting joints shall be watertight and flexible.

Open ends of pipe and branches shall be closed with polyvinyl chloride stoppers secured in place in an acceptable manner.

After each pipe has been properly bedded, enough bedding material shall be placed between the pipe and the sides of the trench, and thoroughly compacted, to hold the pipe in correct alignment. Bell holes, provided for jointing, shall be filled with bedding material and compacted. Bedding above the spring line of the pipe (see Drawings for material) shall be placed and compacted to complete the pipe bedding.

The Contractor shall take all necessary precautions to prevent flotation of the pipe in the trench. At all times pipe installation is not in progress, the open ends of the pipe shall be closed with temporary watertight plugs, or by other acceptable means.

If water is in the trench when work is to be resumed, the plug shall not be removed until suitable provisions have been made to prevent water, earth, or other substances from entering the pipe.

Pipelines shall not be used as conductors for trench drainage during construction.

Low Pressure Air Testing: Upon completion of installation, the Contractor shall provide certified air tests, as directed by the Engineer, on all pipes installed under this Contract.

Air testing will be conducted between structures. The pipe under test shall be plugged at both ends. An air hose shall be connected to a tapped plug to be used for air inlet to the line. The hose will be connected to portable air control equipment, which must include a shutoff valve, pressure

regulating valve, pressure reduction valve and a monitoring pressure gauge with range from 0 to 5 psi.

Air shall be introduced from the air source through the control equipment to the pipeline.

a) Introduce low pressure air into the sealed pipeline until the air pressure reaches 4 psi gauge greater than the average groundwater pressure.

b) Allow a minimum of 2 minutes for the air pressure to stabilize to a minimum of 3.5 psi gauge greater than the groundwater pressure. Groundwater is assumed to be at ground surface unless the Contractor can prove by otherwise by test pitting.

c) After the stabilization period, disconnect the air hose from the control panel to the air supply.

d) The pipeline will be acceptable if the pressure decrease is not greater than 0.5 psi gauge in the time stated in the following table for the length of pipe being tested:

Time (Min.) for Length of Pipe

Pipe Diameter	0-99’	99-200’	200-300’	300-400’
4”	2.0	2.0	2.0	2.0
6”	3.0	3.0	3.0	3.0
8”	4.0	4.0	4.0	5.0
10”	5.0	5.0	6.0	8.0
12”	5.5	5.5	8.5	11.5
15”	7.0	8.5	13.0	17.0
18”	8.5	12.0	19.0	25.0
21”	10.0	17.5	26.0	35.0
24”	11.5	23.0	34.0	45.5
27” and larger	14.5	29	43.0	58.0

Test Results:

a. If the installation fails the low pressure air test, determine the source of leakage.

b. Repair or replace all defective materials and/or workmanship and repeat low-pressure air test at no additional cost.

Allowable Pipe Deflection: Plastic pipe provided under this specification shall be so installed in the ground that a deflection of no more than 5 percent can be anticipated. Such deflection shall be computed by dividing the amount of deflection (nominal diameter less minimum diameter when measured) by the nominal diameter of the pipe. However, between any two adjacent drainage structures, the average deflection shall not exceed 6 percent and no deflection at any point in the pipe shall exceed 7 percent, computed in the manner described herein.

Place Concrete Waterstops full width of trench from bottom of trench to 12" above pipe at the midpoint of each run that is greater than 100' between structures or as directed by the Engineer. Forms are not required however the Contractor may utilize them to restrain the width of the stop. A minimum width of 6" is required for each stop. Waterstops are not required for runs less than 100' between structures.

Buried Utility Markings: The Contractor shall install buried utility markings as called for in the contract drawings or as directed by the Engineer. Colored marking tape shall be labeled "**Caution Buried Storm Drain Line Below"**.

Article 6.51.04 Method of Measurement:

Add the following:

No. 6 Crushed Stone, Geotextile and Temporary Earth Retaining System shall be measured for payment as specified elsewhere.

Waterstops shall not be measured for payment.

Article 6.51.05 Basis of Payment:

Add the following:

Included in the unit price of the pipe shall be the cost of testing.

Included in the unit price of the pipe shall be all gaskets and waterstops.

PVC Pipe shall be paid for as "(Size) Polyvinyl Chloride Pipe".

Pay Item	Pay Unit
36" Polyvinyl Chloride Pipe	L.F.
6" Polyvinyl Chloride Pipe	L.F.
12" Polyvinyl Chloride Pipe	L.F.
18" Polyvinyl Chloride Pipe	L.F.
24" Polyvinyl Chloride Pipe	L.F.
30" P.V.C. Pipe	L.F.

ITEM #0702396A – DRIVING PRESTRESSED CONCRETE PILES

Work under this item shall conform to the requirements of section 7.02 supplemented and amended as follows:

Subarticle 7.02.01 – Description: *Supplemented and amended as follows:*

Contractor shall conduct a Pre-Pile Driving Meeting at the Project Site in compliance with the requirements of Form 816 Subarticle 1.20-1.05.24-2. After the specified submittals have been provided, the Contractor shall schedule a meeting to review procedures for driving the precast prestressed piles. The Contractor shall require attendance by responsible representatives of every party who is involved with the pile driving work including, but not limited to, the following:

1. Contractor's superintendent.
2. Testing Agency responsible for the pile load testing.
3. Pile driving Sub-contractor.

The Designer will be present at the meeting and must be notified at least 10 days prior to the scheduled date of the meeting. Minutes of the meeting shall be recorded, published and distributed by the Contractor to all parties concerned within 5 working days of the meeting.

Subarticle 7.02.03-5(c) – Instrumentation: *Supplemented and amended as follows:*

All piles shall be driven using fixed leads. Leads shall be straight and parallel, not deviating from a straight line by more than 0.5 inches over any 15 foot length. Leads shall be easily adjustable to permit driving without interruption if piles deviate from their required alignment.

Restraints (such as chains) shall be provided to maintain the piles within the leads without bowing during driving.

Subarticle 7.02-03-8 – Driving Piles: *Supplemented and amended as follows:*

Piles shall be installed within a minimum tolerance of 3” from design location. Down drag soil force shall be 13 tons (static) and 8 tons (liquefaction).

The Contractor shall provide pile location survey data for all piles driven so that the Engineer can analyze and evaluate the configuration of the piles and determine the need for potential additional piles or modifications to pile caps resulting from as driven locations. The survey data will be forwarded to the Engineer on a daily basis during pile driving.

ITEM #0702801A – PILE LOADING TEST

Work under this item shall conform to the requirements of section 7.02 supplemented and amended as follows:

Subarticle 7.02.01 – Description: *Supplemented and amended as follows:*

Contractor shall conduct a Pre-Pile Loading Test Meeting at the Project Site in compliance with the requirements of Form 816 Subarticle 1.20-1.05.24-2. After the specified submittals have been provided, the Contractor shall schedule a meeting to review procedures for load testing the precast prestressed piles. The Contractor shall require attendance by responsible representatives of every party who is involved with the pile load testing work including, but not limited to, the following:

1. Contractor's superintendent.
2. Testing Agency responsible for the pile load testing.
3. Pile driving Sub-contractor.

The Designer will be present at the meeting and must be notified at least 10 days prior to the scheduled date of the meeting. Minutes of the meeting shall be recorded, published and distributed by the Contractor to all parties concerned within 5 working days of the meeting.

Subarticle 7.02.03-10 – Determination of Bearing Values of Piles: *Supplemented and amended as follows:*

Load test piles shall have three 0.5 inch internal diameter Schedule 40 PVC pipe installed within the pile for telltale installation. The pipes shall terminate at the bottom, lower quarter and midpoint of the pile. During load testing, movement of the pile shall be monitored by the telltales.

All load test piles shall be 80 feet long and have bitumen coating applied for the upper 45 feet.

The loading frame shall be capable of loading the test pile to 2.0 times the design pile capacity of 50 tons.

The general loading procedure will be the Quick Load Test Method as specified in ASTM D-1143. The test pile shall be loaded to the design capacity, unloaded and then loaded to 2.0 times the design capacity.

At 2.0 times the design capacity, creep will be monitored. Twice the design capacity load shall be held for one hour. After creep has been monitored, unload the pile in accordance with ASTM D-1143. Take readings at the zero load for one-half hour.

ITEM #0821206A – PRECAST CONCRETE BARRIER CURB (24” X 32”)

Section 8.21 is supplemented and amended as follows:

Article 8.21.03 Construction Method:

Add the following:

7. All precast units shall be new and conform to the details included within this specification. All units shall be installed at grade. Precast units shall not be buried or recessed into the ground.

8. Vertical 4 inch white painted pavement markings to be applied to barrier faces to mark parking stalls of a 9 foot width where called for on the plans.

9. Reflective warning lenses or tape shall be applied to the ends and sides of barriers visible to traffic in areas designated for vehicle movements. Type and installation of reflective devices shall be as directed by the engineer.

10. All precast units shall remain property of the owner.

Article 8.21.05 Basis of Payment:

Add the following:

Included in the unit price of the barrier shall be the cost for the vertical white paint and the reflective devices.

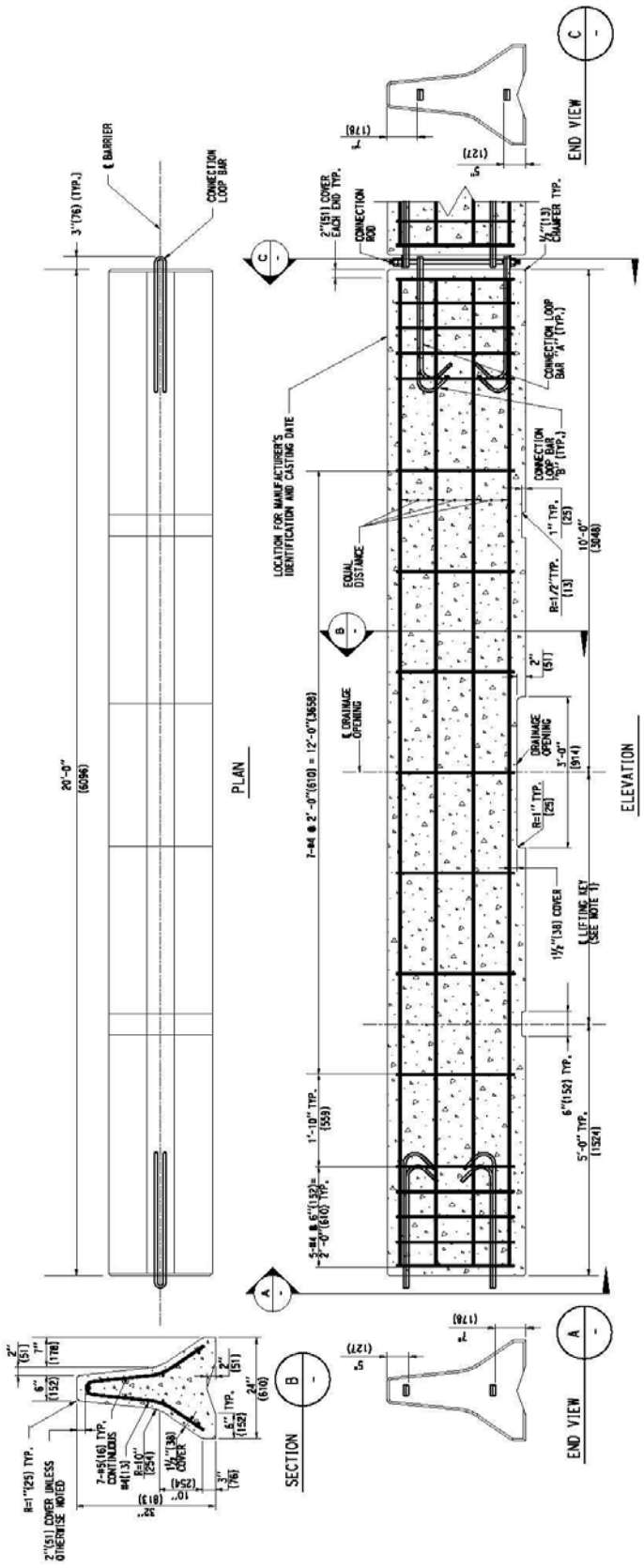
PLAN
ELEVATION
SECTION
END VIEW
END VIEW
℄ BARRIER
CONNECTION LOOP BAR
3"(76) (TYP.)
20'-0"
(6096)
2"(51) COVER EACH END TYP.
CONNECTION ROD
¾"(13) CHAMFER TYP.
CONNECTION LOOP BAR "A" (TYP.)
CONNECTION LOOP BAR "B" (TYP.)
LOCATION FOR MANUFACTURER'S IDENTIFICATION AND CASTING DATE
EQUAL DISTANCE
1" TYP. (25)
R=1½" TYP. (13)
10'-0" (3048)
2" (51)
℄ DRAINAGE OPENING
DRAINAGE OPENING 3'-0" (914)
R=1" TYP. (25)
7-#4 @ 2'-0"(610) = 12'-0"(3658)
1½"(38) COVER
℄ LIFTING KEY (SEE NOTE 1)
1'-10" TYP. (559)
6"(152) TYP.
5'-0" TYP. (1524)
5-#4 @ 6"(152)= 2'-0" (610) TYP.
(178)
7"
(127)
5"
2"
(51)
7"
(178)
6"
(152)
2"
(51)
24"
(610)
6" TYP. (152)
3"
(76)
R=1"(25) TYP.
2"(51) COVER UNLESS OTHERWISE NOTED
7-#5(16) TYP. CONTINUOUS
#4(13)
R=10" (254)
1½"(38) COVER
10" (254)
20" (610)

TABLE A
FLARE RATES
* SPEED
FLARE RATE (X : 1)
≤ 30MPH(48KPH) 4 : 1
> 30MPH(48KPH) <45MPH(72KPH) 6 : 1
≥ 45MPH(72KPH) NON-LIMITED ACCESS HIGHWAYS 8 : 1
ALL LIMITED ACCESS HIGHWAYS 10 : 1
* DESIGN SPEED THROUGH THE WORK AREA.
TERMINAL TREATMENT AS SHOWN ON THE PLANS OR AS DIRECTED BY THE ENGINEER
TEMPORARY PCBC (FLARE RATES VARY, SEE TABLE A)
WORK AREA
1
X
DIRECTION OF TRAFFIC
PLAN - TYPICAL INSTALLATION
GENERAL NOTES:
1. ALTERNATE DESIGNS FOR LIFTING KEYS, HOLES OR OTHER HANDLING DEVICES MAY BE SUBMITTED TO THE ENGINEER FOR APPROVAL.
2. MATERIALS SHALL CONFORM TO THE DEPARTMENT'S STANDARD SPECIFICATIONS AND SUPPLEMENTALS.
3. ALL METRIC DIMENSIONS ARE IN MILLIMETERS (mm) UNLESS OTHERWISE NOTED.
1⅜" (35)
2¾" (70)
WASHER DETAIL
1⅜"(35) DIAMETER
℄ BAR
PLAN
25"(635) FOR BAR "A"
28"(711) FOR BAR "B"
℄ BAR
¾" (2) DIA. SMOOTH BAR TYP. GALVANIZED
135°
R= 2"(51)
8"(203)
ELEVATION
BAR "A" = 6'-0"(1829) TOTAL
BAR "B" = 6'-6"(1981) TOTAL
CONNECTION LOOP BAR
30" (762)
TWO HEAVY HEX NUTS AT TOP. ONE HEAVY HEX NUT AT BOTTOM. ONE STEEL FLAT WASHER TOP AND BOTTOM. SEE WASHER DETAIL. ALL GALVANIZED.
1"(25) DIA. ROD GALVANIZED
THREAD CONNECTION ROD A MINIMUM OF 4"(102) TYP.
CONNECTION ROD

ITEM #0969050A – DOCUMENT CONTROL SPECIALIST

Description: Under this item the Contractor shall furnish the services of one of his administrative employees, entitled Document Control Specialist who will ensure that the Contractor and all other parties as designated by the Engineer will prepare, status, electronically file and send all project correspondence and drawings utilizing a document control system as established and maintained by the Department. The primary function of the document control system is to ensure timely processing of all contract documentation in coordination with the project schedule. This document control system will also provide uniform project information and reporting. The Document Control Specialist shall be designated by name, in writing with a resume of their qualifications, within five (5) calendar days of the award of the Contract and shall not be changed without prior written notice to the Department.

The Document Control Specialist shall be knowledgeable of the status of all contract documentation aspects of the work throughout the length of the Contract. The Contractor shall prepare and maintain the contract documentation utilizing the latest version of Primavera Contract Manager (PCM) software (formerly known as Primavera Expedition). The document control system will be physically located in a secure location designated by the Department. The Contractor will directly access the document control system via the internet. The Department will provide the Contractor access to the latest version of PCM and a common file server. All references to the use of PCM and the common file server below shall refer to the Department's shared document control system as described above. All information that resides on the shared document control system shall become the sole property of the Department.

The minimum lump sum bid for this item shall be **$75,000** (seventy five thousand dollars). Failure of the Contractor to bid at least the minimum amount will result in the Department adjusting the Contractor's bid to include the minimum bid amount for this item.

Documentation Requirements: All correspondence for the project, with the exception of letters, shall be produced, distributed, and controlled using PCM including, but not limited to: transmittals, meeting minutes, requests for information (RFI's), requests for change (RFC's), submittals, answers, reports, agendas, field memos, notices, and punch lists. All common correspondence files shall be stored within the common file server, including any and all file attachments. Submittals, including shop drawings, working drawings, catalog cuts, material certifications, and all documentation required by contract, shall be submitted electronically via PCM. The Contractor is responsible to coordinate the overall creation and submission of all project documentation to meet the requirements of the project schedule and specifications. The Contractor is required to be able to make electronic submittals as well as accept and work with electronic submittals marked "Conforms" or "Conforms as Noted". The Contractor is encouraged to supply the Department with corporate logos, formats, Sybase Infomaker files, etc. to facilitate the creation and utilization of custom forms and reports. The Project Document Control System will be equipped with a Microsoft Office Suite of software (Word, Excel, etc.) to

be used for final preparation of electronic documents to be utilized by all users to ensure version compatibility.

The named Document Control Specialist shall be designated as the Submittal Coordinator within PCM and will be responsible for maintaining information related to the responsibility, status, elapsed time since submission, held time, start/finish times, and a history of all submittal revisions. A submittal log must be maintained to indicate the latest construction submittals sent and received and the distribution of these drawings to the Department. Each submittal (shop drawing, working drawing, product data, samples, etc) must be individually entered, tracked, and the status maintained, including all revisions. The Contractor is responsible to utilize the latest drawings marked "Conforms" or "Conforms as Noted" as identified in the control system. All revisions are to be logged into the control system, describing each change.

All meeting minutes shall be logged into the control system. The Contractor is responsible to utilize meeting minutes and respond (electronically) to meeting minute items assigned to the Contractor.

Documents (letters, logs, shop or working drawings, sketches, payrolls, etc) to be transmitted to the Department by the Contractor, for which the Contractor does not have an electronic version, shall be scanned, converted into an Adobe Acrobat PDF format, and attached accordingly in PCM.

The document control system shall be available for Contractor use at all times unless system maintenance (i.e. backups, upgrades, etc) is being performed. System maintenance will generally be limited to 10 PM – 6AM, Monday - Friday and at various times on weekends. In the event a Contractor's authorized user cannot access the control system, the Contractor shall notify the Department's control system representative. In the event the control system becomes unavailable during normal business hours for an extended period of time, the Contractor may issue correspondence requiring immediate attention by the Department in hard copy format. The hard copy correspondence must be entered into the control system immediately upon becoming available again. Inability by the Contractor to gain access to the document control system for any reason shall not be grounds for claim. The use of the database is not required for proprietary cost and contract information.

The Department shall be allocated a minimum of ten (10) calendar days (using a 7-day calendar, exclusive of holidays) for review and response to each RFI submitted. RFI's requiring information from outside agencies shall be allocated twenty-one (21) days (using a 7-day calendar, exclusive of holidays).

The Department shall be allocated a minimum of thirty (30) calendar days (using a 7-day calendar, exclusive of holidays) for review and response to each RFC submitted. RFC's requiring information from outside agencies shall be allocated sixty (60) days (using a 7-day calendar, exclusive of holidays).

The Department reserves the right to reject any RFC submitted in the form of an RFI for the purpose of reducing the Department's review and response time. Such documents will not be

considered for review by the Department and will be returned to the Contractor for resubmission. Review and response time for such document will commence upon resubmission in the correct format.

The Department shall be allocated a minimum of twenty-one (21) calendar days (using a 7-day calendar, exclusive of holidays) for review and approval of each submittal, unless specified otherwise within the contract documents. Any submittals requiring approval by an outside Agency (ConnDEP, Metro-North Railroad (MNR), etc.) shall be allocated a minimum of sixty (60) calendar days (using a 7-day calendar, exclusive of holidays). Any submittals requiring approval by FM Global or the Commissioning Agent shall be allocated a minimum of twenty-eight (28) calendar days (using a 7-day calendar, exclusive of holidays). (Refer to "NOTICE TO CONTRACTOR – METRO-NORTH RAILROAD SUBMITTALS", "NOTICE TO CONTRACTOR – COMMISSIONING RELATED SUBMITTALS", and "NOTICE TO CONTRACTOR – FM GLOBAL SUBMITTALS" for Contractor submittals required by these agencies.) A schedule of submittals shall be submitted to The Department for review prior to the start of construction. These durations are a MINIMUM, and will likely increase with the number of outstanding submittals in The Department's possession. Therefore, whenever multiple Contractor submittals are under review by the Department, the Contractor shall prioritize the submittals and notify the Department thereof. The submittal schedule must be submitted early for review as a subset of the baseline schedule. The Department shall not be held responsible for any delay associated with the approval or rejection of any substitution or other revisions proposed by the Contractor.

Submittal and review activities are required in the Project Schedule per Item No. 0969000A, Project Coordinator. Submittal activities must be coordinated between the Project Coordinator and Document Control Specialist such that submittal information common to both the project schedule and the document control system (required and actual dates, sequence of submission, resubmissions if required) correspond with one another. All resubmissions shall be numbered with the original submittal number but designated a new revision number. All resubmissions shall be logged into the control system to properly calculate the entire duration required for the submittal process from the original submission date to final approval to indicate total days to process the submittal through all review cycles. Coordination of submittals is required for same work and interfacing work so that one submittal will not delay another.

Refer to the following Notices to Contractor for additional submittal requirements:

- Early Submittals
- Submittals
- Metro-North Railroad Submittals
- Commissioning Related Submittals
- FM Global Submittals
- Closeout Documents

The submittal log will be developed according to the following format:

Submittal Package

The Package name shall be the seven digit Item Number. The Package Title shall be the corresponding Item Name. Instances where contract items require an extensive number of submittals (i.e. rebar, structural steel, etc), packages shall be further separated by structure components or location. For example:

Package	Title
0602006-01	Deformed Steel Bars – Epoxy Coated / Abutment 2
0602006-02	Deformed Steel Bars – Epoxy Coated / PN-13
0602006-03	Deformed Steel Bars – Epoxy Coated / PN-14

Instances where a submittal requires review by more then one department or agency (i.e. requiring both ConnDOT and MNR reviews), the multiple reviewers option must be checked so that the individual reviewers can be designated, with each receiving a copy of the submittal for review.

The Package status shall initially be "Unsubmitted". Upon submission of any submittal within the package, the status should be changed to "Open". Upon receipt of all final review comments for all package submittals, the status should be changed to "Closed".

Submittal Item

All submittal items, as required by contract, must be individually entered, including shop & working drawings, product data, samples, etc. All submittals shall be associated with and generated within a specific package. The submittal number shall be the package name followed by a three digit incremental number (i.e. 1205201-01-001, 0602006-03-001). The Title shall be a clear description of the submittal item. In the case of a drawing submittal, the title shall be the exact name of the drawing and the drawing number shall be entered in the Details section. The appropriate Category and Type shall then be selected.

The Contractor shall examine and check each submittal for accuracy, completeness, coordination with related submittals and compliance with the Contract before it is transmitted to the Designer for review. The Contractor shall sign and submit the Submittal Register Form (sample attached to this section and available electronically in PCM) with each submittal which includes the following statement: "Having reviewed this submittal, I certify that it is complete, accurate, coordinated in all aspects of the item being submitted and conforms to the requirements of the Contract in all respects, including all Federal requirements such as "Buy America", except as otherwise noted." By reviewing and certifying each submittal, the Contractor represents that he has determined and verified materials, field measurements and field construction criteria related thereto, and has checked and coordinated information contained within such submittals with requirements of the Work and the Contract. Shop drawings submitted without this signed statement will be rejected immediately and returned to the Contractor.

Shop drawings shall be submitted in Adobe Acrobat PDF Package format. Each drawing will be included as a separate file within the package and named in kind with the drawing number. The PDF package shall be listed and attached in PCM to the first submittal. The drawings shall be listed individually thereafter.

Working drawings shall be submitted in Adobe Acrobat PDF format. The PDF package shall be listed and attached in PCM to the first submittal. The drawings shall be listed individually thereafter.

Electronic submittal attachments shall be named in kind with the submittal to which they are attached and include the revision number (ie. Submittal 0602006-03-001 would have a PDF attachment named 0602006-03-001-1.pdf).

Submittal of samples for review and approval by the Designer shall be submitted using the PCM-generated transmittal. The Contractor shall ship the quantity of physical samples required by the contract to the Designer with the hard copy of the transmittal. The Designer shall generate the return transmittal in PCM (indicating the sample's review status as to Conforms, Conforms as Noted, Revise and Resubmit, Rejected, or No Action Required) and transmit it to the Contractor. The Designer shall retain one set of samples marked "Conforms" or "Conforms as Noted", transmit one set of same to the Engineer, and transmit the remaining sets of same to the Contractor.

Submittals requiring a signature by a licensed engineer or other party shall be digitally signed utilizing a digital ID obtained from an Adobe partner Certified Document Service (CDS) provider (see adobe.com for the list of CDS providers).

Required Start & Expected Finish shall represent the date range for the review process. Required Start shall be the date the submittal is issued by the Contractor for review. Expected Finish shall be the completion date for the review cycle (either 21 or 60 days later, as appropriate).

Workflow must be completed for each submittal. Received From shall be the party from which the submittal originated (prime contractor, subcontractor, fabricator, vendor, etc). Sent To and Returned By shall be the primary reviewer as designated by the contract documents. Forwarded To shall be the Contractor's designated submittal coordinator.

Review cycles will be numbered 001, 002, 003, etc. according to the number of resubmissions. Distributions (submittal recipients) must be listed on the transmittal.

Hard copies of all submittals marked "Conforms" or "Conforms as Noted" shall be transmitted within 5 working days as follows:

# of Copies	**Send To:**
3	ConnDOT District Office
3	Metro North Railroad
1	Commissioning Agent (if reviewed)
1	State Building Official (if needed)

The Contractor shall submit hard copies of all letters signed in ink with any attachments to the addressee (original) and the ConnDOT District Office (copies) for their records. Scans of signed letters and their attachments shall be stored in PCM by the Contractor. The Contractor shall submit wet stamped hard copies of all conformed shop drawings requiring the signature of a

professional engineer (eg, steel bar joists, etc.) to the Department to transmit to the State Building Officials for their records. Scanned copies of these conformed shop submittals or other electronic copies will be stored by the Contractor in PCM. The Contractor shall submit hard copies and electronic copies of Maintenance Manuals and Warranties.

Submittal Forecast

In order to facilitate the Department's review of the large number of submittals anticipated for this project, the Contractor is to provide a submittal schedule in accordance with the Standard Specifications (Form 816) Section 1.20-1.05.02 Subsection 3, and as described herein. The submittal schedule will be created and maintained in PCM as follows:

A submittal package must be created for each contract item requiring a submittal (note that large submittal items must be broken out as prescribed above). Within each package, a single submittal, numbered 001, will be generated from the submittal package which will be utilized to approximate when submittals for that package will be submitted for review. At a minimum, the submittal Number, Title, Status, Required Start, and Required Finish must be entered, where the Status is "Unsubmitted" and the Required Start and Required Finish represents the review period for all submittals within this package. The Required Start and Required Finish dates must be coordinated with the project CPM schedule.

Additionally, the Contractor shall prepare and distribute a 60 day "Look Ahead Submittal Schedule", to be updated weekly and presented and discussed at the project coordination meeting as part of the standing meeting agenda. The Look Ahead Submittal Schedule will be based on the CPM schedule (without limitation on early submittals), and will provide the following in matrix/spreadsheet format:

- Contract Item No. (Note - for the MLSI, provide CSI Division No. & Specification Section No.)
- Contractor's best estimate to identify the actual submittals to be made for those Contract Items or specification sections with multiple submittals
- Contractor's best estimate of a target date the identified submittals will be made
- Identification of planned "Hot Submittals" needed to support near-term construction activities
- Identification of planned "Major Submittals" which are anticipated to require significant review effort (e.g., coordination drawings)

Documentation Control System Access Requirements: Within five (5) days of Contract Award, the Contractor shall designate, in writing, up to five (5) named Contractor personnel, to be approved and authorized by the Engineer to access the document control system. The Contractor shall designate one of the ten authorized personnel to be the Document Control Specialist and act as the document control system contact person for the Contractor. That person shall be experienced and trained in the use of PCM. All Contractor personnel requesting access authorization must complete the minimum training requirements described below and submit a certificate of completion to the Department. Upon receipt of the request (with training certificate(s)) and approval thereof, the Department will issue a username and password to each

of the authorized Contractor personnel. The Contractor will ensure that only authorized Contractor personnel access and utilize the control system in a responsible, non-destructive manner. The Contractor shall make every reasonable effort to prevent the disclosure of access information for unauthorized use of the control system. The Department, at its discretion, may revoke access authorization from any user if it is determined that the user: a) has used the control system for any other reason then is intended by this specification; b) is no longer in the Contractor's employ or associated with the project or c) has disclosed their access authorization for use by another person or party for any reason. The Contractor is responsible to ensure their authorized users have access to the public internet from a computer system running any currently supported Microsoft Windows Operating System and Microsoft Internet Explorer Web Browser with a minimum Cipher Strength of 128 bit, version 5.5, 6.0, or 7.0. Minimum modem speed shall be 56K. The Contractor is responsible to ensure that anti-virus software is installed and maintained on any computer accessing the Department's document control system. Additionally, it is the Contractor's sole responsibility to maintain a compatible software system. Compatibility is defined as the ability to send and receive documents in a format viewable by the Department. The Contractor must provide valid individual email addresses for each authorized user to the Department based upon a MAPI compliant email system, such as Microsoft Outlook or Exchange.

Training Requirements: Contractor personnel accessing the document control system must fulfill minimum training requirements as follows: personnel must attend a two (2) day project specific PCM training class provided by PL Logic, One Alewife Center, Cambridge, MA 02141, (Tel 617-494-9900, Web site: www.pllogic.com). The Contractor must supply an acceptable training facility within 15 miles of the project site. The costs of all Contractor personnel training and the training facility are the responsibility of the Contractor. Training facility shall have a computer workstation for each student in addition to a computer for the instructor. The instructor computer must be able to project to a screen/wall for classroom illustrations via a digital projector or large screen monitor (Minimum 40"). The computer workstations must be a minimum Pentium 2 GHz with 512MB of RAM, 200MB free disk space, running Windows XP/2000/NT 4(Service Pack 6). Additional workstation requirements include Microsoft TCP/IP networking protocol and a valid IP address, Microsoft Internet Explorer 5.50 SP2, 16-bit or higher color video, and 800x600 video resolution minimum. Training facility shall have one (1) database server with the minimum specifications of: Pentium, 1 GHz, 512 MB RAM, 1.5 GB free disk space, running Windows 2000/XP Professional/NT 4 (Service Pack 6), or Novell 5.x. and one (1) web server with the minimum specifications of: Pentium 2 GHz, 1 GB RAM, 200 MB free disk space, running Windows 2000/NT 4 (Service Pack 6), Microsoft TCP/IP networking with a permanent IP address, the port for the web server requests is 80 (the port is configurable, although port 80 is recommended), a local user account (local to the domain) on the server with read rights to the PCM report and forms directories, and access to the database server. Note that the database server and web server cannot run on the same hardware.

Any additional training required as a result of adding additional or replacing existing Contractor staff, including additional costs associated with meeting hardware requirements to run the latest version of the software at that time, shall be included in the total cost of this item.

Submittals: Within thirty (30) calendar days after award, the Submittal Coordinator shall prepare, in accordance with all requirements of this specification, and submit for review and acceptance, a Submittal Forecast and shall have the following requirements attached:

- Submittal Packages Summary Report
- Submittal Bar Chart Report

Method of Measurement: Within ten (10) calendar days of the award of the Contract, the Contractor shall submit to the Engineer for approval a cost breakdown of his lump sum bid price. The submission must include substantiation showing that the costs breakdown submitted are reasonable based on the Contractor's lump sum bid. The cost breakdown shall be in accordance with the following payment schedule:

1) The cost to successfully complete all preparation and training to utilize the document control system in accordance with these specifications. The preparation and training costs shall not exceed 5% of the total cost of the item and shall include costs to establish customized forms or reports, back enter and scan all contract documentation prior to the access authorization, and to furnish and install all specified hardware.

2) The development cost to prepare the Submittal Forecast in accordance with these specifications shall not exceed 5% of the total cost of the item. Payment for this work will be made upon acceptance of the Submittal Forecast by the Engineer.

   The cost to provide services of the Document Control Specialist, including costs to maintain the Submittal Forecast; Coordinating the Document Control System submittal information with the CPM Schedule submissions; preparing, submitting, utilizing, maintaining, coordinating and updating document control system items as required by all Contractor personnel with access rights to the system Shall be paid as a per month cost and shall be derived by taking this cost divided by the number of contract months.

Basis of Payment: This service shall be paid for at the contract lump sum price for "Document Control Specialist" complete, which price shall include the training, preparation, statusing, electronically scanning, filing, and sending all project correspondence, and the furnishing, maintenance, and supply costs for all required hardware, software, and services as noted above in the utilization of the document control system as established and maintained by the Department. The lump sum price will be certified for payment as described in "Method of Measurement" subject to the following conditions:

1) Failure by the Contractor to utilize and regularly update the specified PCM database in a manner acceptable to the Department or failure to utilize the common file server for the storage of all project related files may result in the withholding of all contract payments until such time as all specification requirements have been satisfied. Failure by the designated Document Control Specialist to update submittal statuses on a regular basis shall result in the replacement of the Document Control Special at the Engineer’s request. Additionally, the Contractor may be found in violation of Article 1.02.02 of the Standard Specifications "for having failed to prosecute work continuously, diligently and cooperatively in an orderly

sequence".

2) In the event the project extends beyond the original completion date by more than thirty (30) calendar days, and a time extension is granted to the Contractor, the Department may require the continued utilization of the Document Control System which shall be paid at the per month cost for the services of the Document Control Specialist.

Pay Item	Pay Unit
Document Control Specialist	L.S.

SUBMITTAL REGISTER FORM

The use of this Submittal Register Form is required for all submittals

Project Name: NEW HAVEN RAIL YARD INDEPENDENT WHEEL TRUING FACILITY
State Project No. 301-0139
Connecticut Department of Transportation

Design Engineer: PB Americas

Contractor: _____

Address: _____

Telephone No.: _____

Subcontractor: _____

Address: _____

Telephone No.: _____

Submittal Number: _____

Submittal Title: _____

Specification Section and Paragraph Number: _____

Contract Drawing and Detail Reference: _____

Date of Initial Submittal: _____

Date of this Submittal: _____

CPM Activity Number: _____

This Submittal Prepared By: _____

Having reviewed this submittal, I certify that it is complete, accurate, coordinated in all aspects of the item being submitted and conforms to the requirements of the Contract in all respects, including all Federal requirements such as "Buy America" except as otherwise noted.

By: _____
Signature

_____
Printed or Typed Name

_____
Title

_____
Date

ITEM #0980101A – CONSTRUCTION STAKING (SITE 1)

Description:

Under this item, the Contractor shall perform, including related administrative and procedural requirements, the following: construction layout and staking, field engineering and surveying, utility locations, resetting duct bank markers and benchmarks disturbed by construction and general support services related to proposed construction methodology involving structural integrity or personnel safety, and civil engineering services.

Submit a certificate signed by the Contractor and co-signed by a Land Surveyor or Professional Engineer certifying that the location and elevation of improvements comply with the Contract.

Submit a record of Project work performed and project data as required under provisions of Form 816 Article 1.20-1.08.14.

Engage a Land Surveyor licensed in the State of Connecticut who is experienced in providing land-surveying services of the kind indicated.

Engage a Professional Engineer of the discipline required, licensed in the State of Connecticut, to perform engineering services of the kind indicated.

Materials:

Project Record Drawings: Appropriate scale reproducible final drawings shall be submitted to the Engineer. Drawings shall conform to the Connecticut General Statues, Section 20-300b with a Horizontal Accuracy of A-1 and a Vertical Accuracy of V-2.

Construction Methods:

The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning site work, investigate and verify the existence and location of underground utilities and other construction affecting the work. Various markers indicating the presence of subsurface duct banks and utilities are present and may be disrupted by construction activities. Furnish location data for Project work that must be performed by public utilities serving the Project Site.

Furnish information that is necessary to adjust, move or relocate existing structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction. In cases where these markers are affected by construction, the markers must be replaced or reset in the positions and configurations existing before construction at final grade after grading is completed. Where construction makes it impossible to replace duct bank markers, suitable alternative marker may be substituted as directed by the Engineer.

The existing benchmarks, control points and property corners are shown on the plans.

Verify layout information shown on the plans, in relation to the control points and existing benchmarks before proceeding to layout the Project work. Notify the Engineer if discrepancies are discovered. Locate existing permanent benchmarks, control points, and similar reference points before beginning Project work. Preserve and protect permanent benchmarks and control points during construction operations. Do not change or relocate benchmarks or control points without the Engineer's prior written approval. Promptly report lost or destroyed control points, or the need to relocate permanent benchmarks or control points because of necessary changes in grades or locations. Promptly replace lost or destroyed benchmarks and control points. Base replacements on the original survey control points.

Establish and maintain a minimum of (2) permanent benchmarks on the Project Site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark. Record benchmark locations, with horizontal and vertical data, on Project Record Documents. Provide temporary reference points sufficient to locate the work where the actual location or elevation of layout points cannot be marked. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

Construction methodology shall be the Contractor's sole responsibility including the cost of using engineering services and recommendations as necessary. Inform the Engineer of any anticipated or encountered problems in construction methodology. Proceed with work only when such problems are fully resolved by the Contractor, using such engineering support services as required.

Work from lines and levels established by the control survey. Establish benchmarks and control points to set lines and levels at each area of construction as needed to locate each element of the Project. Calculate and measure required dimensions within indicated or recognized tolerances. Do not scale plans to determine dimensions. Advise entities engaged in construction activities, of marked lines and levels provided for their use. As construction proceeds, check every major element for line, level and plumb.

Locate and lay out site improvements, including pavements, stakes for grading, fill and topsoil placement, utility slopes and invert elevations by instrumentation and similar appropriate means. The Contractor shall identify and document by survey the extent, elevation, and location of all foundations and capped utilities to be left in place and backfilled. Appropriate scaled marked up drawings shall be furnished to the Engineer PRIOR to backfilling.

Locate and lay out control lines and levels for structures, building foundations, column grids and locations, floor levels including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from (2) or more locations.

Locate and lay out lines and grades for the construction of trackwork. Track centerline stakes shall be set at 50 foot stations along each track centerline. Additional stakes shall be set at all points of curvature including tangent to curve, compound curve, curve to tangent points, points of vertical curves and tangents, start and end points, and at all points of switch, PITO's, and frog points. Cut and fill information shall be provided at all staked locations. An offset baseline shall be provided approximately 20' off the centerline of track, or as directed by the Engineer.

Maintain a surveyor's log of control and other survey work. Make this log available to the Engineer for reference. Record deviations from required lines and levels, and advise the Engineer when deviations that exceed indicated or recognized tolerances are detected. On Project Record Drawings, record deviations that are accepted by the Engineer and not corrected. Record the location of utilities at the time of installation in the log as well as on mylar for permanent record. The recording Land Surveyor shall place its registration seal and accuracy statement regarding location of exterior underground utility lines on the utility plans of As-Built tracings.

Method of Measurement:

This item will be paid for at the contract lump sum price for "Construction Staking (Site 1)" complete.

Basis of Payment:

This item will be paid for at the contract lump sum price for "Construction Staking (Site 1)", which price shall include all administrative and procedural requirements, material, equipment, labor, and work incidental thereto.

Pay Item	Pay Unit
Construction Staking (Site 1)	L.S.

ITEM #1020005A - WOOD POLE (45 FEET)

Description: This work shall consist of furnishing and installing a wood pole with bracket, anchors, ground rod, conduit, and all other devices, at the location shown on the plans.

Materials: Wood poles shall conform to the pertinent requirements of Article M.16.04-2. Wood poles shall be 45' in length.

Anchors shall conform to the pertinent requirements of Article M.16.04-2b, c, d, and e.

Brackets shall be fabricated from tubular steel with an upsweep design and shall accommodate a 2" slip-fitter type luminaire. The bracket shall be galvanized and designed for wood pole attachment. Length shall be as called for on the plans.

Ground rods shall be 5/8" x 8' copper-clad steel with an approved square head bolt-type ground clamp.

Ground wire shall be #8 AWG stranded bare soft-drawn copper.

Conduit shall conform to M.15.09.

Back guy or braces shall be encased in high visibility yellow plastic safety covers to a height of eight feet above ground.

Construction Method: The wood pole, with required anchors, bracket, ground rod and ground wire, including excavation of earth or rock, shall be installed as detailed, at the locations shown on the plans.

The actual location of anchor shall be as indicated on the plans and directed by the engineer.

Method of Measurement: This work will be measured for payment by the number of wood poles with associated equipment complete and accepted in place.

Basis of Payment: This work will be paid for at the contract unit price each for "Wood Pole (45 Feet)", as specified and complete and accepted in place which price shall include all materials including wood pole, brackets, conduit, anchors, ground rod, ground wire, including excavation of earth or rock, compacted granular fill and all labor, tools and work incidental thereto.

Pay Item	Pay Unit
Wood Pole (45 Feet)	EA.

ITEM #1108798A – CENTRAL COMMUNICATIONS EQUIPMENT

Description:

Work under this item shall include all labor, materials and services to install aerial and underground communication cables, aerial and underground fiber optics distribution cable, copper pair and fiber optic terminations, pole hardware, and cabling services to indicated buildings and yard telephones on the site communications plan drawings.

Work under this item includes, but is not limited to, furnishing and installing aerial and underground communication cables from pole and/or existing and new manholes to buildings and yard telephones as specified and as shown on the site communications plans. The work also includes new poles and supporting appurtenances to support installation of the new outside plant cabling infrastructure.

The work shall include all materials, equipment and labor incidental for the completion of all work specified.

General:

The following shall be submitted by the Contractor:

Product Data: Provide manufacturer's literature and catalog cuts for aerial and underground communications cables, aerial and underground fiber optics distribution cable, fiber optic terminations, pole hardware, along with new pole information.

Product Certification: Signed by manufacturer of product certifying that products comply with the specified requirements.

Color combinations for pair identification (aerial and underground communication cable).

Materials:

Aerial communication cables shall be self-supporting, air core, figure-8 style, with an integrally assembled galvanized steel support messenger and the quantity of conductor pairs indicated on the plans conforming to RUS (REA) Specification PE-38 Telecommunications Designation.

Aerial Communication Cables:

Conductor: Conductor shall be solid annealed bare copper, No. 22 AWG.

Insulation: Insulation shall be polyolefin. The insulation shall be color coded in accordance with the standard telephone industry specifications.

Twisted Pairs: Individual conductors shall be twisted into pairs with varying lengths to minimize crosstalk and with color combinations to provide pair identification.

The Contractor shall submit color combinations for pair identification to the Engineer for approval.

Cable Assembly: Pairs shall be first assembled into units and then into a cylindrical core. The core shall be undulated with an approximate sine wave configuration to obtain an excess core in the finished cable.

Core Covering: Core covering shall be a non-hygroscopic dielectric tape.

Shield: A self-support shielding system shall utilize a 0.008 inch thick, corrugated aluminum tape applied longitudinally with butted edges.

For tape widths less than 2-1/2 inches, the aluminum shield shall be bare.

For tape widths 2-1/2 inches and greater, the aluminum shield shall be coated on one side with a polymer coating.

Outer Jacket: The outer jacket shall be black polyethylene.

Messenger: The messenger shall be a parallel integral 0.250 inch extra high strength (EHS) stranded galvanized steel suspension wire with a 6,650 test strength.

Identification and Length Marking: The plant location and manufacturer's identification, year and month of manufacture, type of cable (code), and pair size shall be surfaced marked on the jacket at 2 foot intervals.

Sequentially numbered length markings shall be located at alternate 2 foot intervals.

Electrical Characteristics:

Mutual Capacitance

Maximum Average, greater than 12 pairs	83 + 4 nf/mile
Maximum Individual, greater than 12 pairs	92 nf/mile

Capacitance Unbalanced

Pair to Pair

Maximum Individual	80 pF/kft

Maximum RMS, greater than 12 pairs	25 pF/kft

Pair to Ground

Maximum Individual	800 pF/kft
Maximum Average	175 pFlkft
Expected Average Over a QC Lot	105 pFlkft

Power Sum Far End Crosstalk

Frequency	Minimum Mean
0.015 MHz	63 dBlkft
0.722 MHz	49 dBlkft
1.600 MHz	43 dB/kft
3.150 MHz	37 dBlkft
6.300 MHz	31 dBlkft

Frequency	Minimum Worst Pair
0.150 MHz	57 dB/kft
0.772 MHz	43 dB/kft
1.600 MHz	37 dB/kft
3.150 MHz	31 dB/kft
6.30 MHz	25 dB/kft

Power Sum Near End Crosstalk

Frequency	Minimum Mean
0.150 MHz	58 dB/kft
0.772 MHz	47 dB/kft
1.600 MHz	43 dB/kft
3.15 MHz	38 dB/kft
6.300 MHz	34 dB/kft

Frequency	Minimum Worst Pair
0.150 MHz	53 dB/kft
0.772 MHz	42 dB/kft
1.600 MHz	38 dB/kft
3.15 MHz	33 dB/kft
6.30 MHz	29 dB/kft

Attenuation at 20 degrees C

Frequency	Maximum Average
0.772 MHz	4.7 dB/kft

Insulation Resistance at 20 degrees C
Minimum Individual 1.0 gigohm-mile

High Voltage Test
DC Voltage for 3 seconds
Conductor to Conductor 4,000 VDC
Conductor to Shield 10,000 VDC

DC Conductor Resistance at 20 degrees C
Maximum Individual 91.0 ohms/mile
Expected Average Over QC Lot 88.5 ohms/mile

Resistance Unbalance
Maximum Individual 5.0 percent
Maximum Average 1.5 percent
Expected Average Over a QC Lot 1.1 percent

Shield Resistance
Maximum 0.75/D ohms/kft

D =diameter over the aluminum shield in inches.

Aerial Fiber Optics Distribution Cable:

The aerial fiber optics distribution cable shall be a self-supporting figure-8 style cable that is specifically designed for aerial applications strung from poles using standard strand clamps.

Aerial fiber optics distribution cable shall be mini-bundle figure-8 type.

Figure-8 cables shall be loose buffered, gel-filled and contain a dielectric central member.

Loose buffer design of the cable shall eliminate forces against the fiber from temperature cycling, sagging between poles and movements due to the wind.

The outer jacket shall be UV protected medium density polyethylene (MDPE).

The messenger shall be 8.2M 0.250 inch EHS galvanized steel with a breaking strength of 8000 pounds.

For each termination provide a breakout kit for direct connectorization.

Provide a "spider kit" for each cable separated from the messenger inside building entrances.

Fiber size shall be 8.3/125 urn, single mode.

The aerial fiber optics distribution cable shall be non-NEC rated.

Maximum attenuation shall be 0.5/0.4 dB/km at 1310/1550 nm.

Number of fibers shall be as indicated on the site communications drawings.

The optical fiber cable shall install virtually the same as figure-8 communication cable.

Underground Communications Cable:

Under ground communications cable shall be shielded air core OSP cable shall be installed in duct banks and manholes as indicated between buildings.

The cables shall consist of:

#22 AWG multi-pair copper cables with number of pairs as indicated on the Contract Plans.

The cables shall have a polyethylene thermoplastic insulation and jacket, aluminum shield and shall conform to RUS (REA) Specification PE-22.

Underground Fiber Optic Distribution Cable:

Cable shall be an all dielectric, outdoor stranded loose tube 144 or 24 fiber single mode or multimode cable (as indicated on the site communications drawings) with water blocking system utilizing only dry materials.

The cable shall meet the mechanical and environmental requirements of Telcordia GR-20-CORE and ANSI/ICEA S-87-640.

The cable shall be Berk-Tek Adventum, Product Number LTR12BO144-AB0504, SYSTIMAX Teraspeed, Product Number 5125 144A WPBK or approved equal.

Building Entrance Terminals (BET):

The building entrance terminals shall have combined protection and distribution with a built-in storage area for all unused cable pairs.

The protector modules shall protect against overvoltage and overcurrent.

The terminals shall be housed in a weatherproof galvanized steel enclosure with a gasketed hinged cover. The enclosure shall accommodate the quantity of conductor pairs indicated on the plans.

Provide a No.6 AWG solid copper ground wire and a 3/4 inch by 10 foot ground rod at each BET location.

Protectors:

Protectors shall be low noise, 5-pin gas-tube type with heat coils.

The protectors shall have vent-safe and fail-safe mechanisms to ensure automatic short to ground in the event of sustained or high current conditions.

Aerial Cable Splice Kits:

Aerial cable splice kits shall be weatherproof and UV protected thermal plastic with an overclosure and a metal internal supporting structure. The housing shall contain the necessary quantity of splice trays to serve the cable. Provide sealing compounds for complete leakproof seals.

Fiber Optic Splice Cabinet:

Provide weather resistant cabinets, where indicated on the plans, for the protection of the fiber optic cable and for loop splicing of the cable. The cabinets shall be designed for pole mounting. Provide mounting hardware for the cabinets.

Fiber Optic Cable Slack:

Provide cable slack in the form of a figure 8 every 500 feet. Cable shall not be bent tighter than 2 times the recommended minimum bend radius of the cables.

Aerial Duct:

Provide figure-8 aerial duct where indicated on the plans.

Figure-8 aerial duct shall be manufactured using UV stabilized HDPE

The HDPE material shall conform to ASTM D 1248, Type III, Grade P34, Category 5, Class C.

The aerial duct shall be 1-1/4 inch diameter, SDR 13.5, conforming to ASTM D 3035, with a smooth interior wall.

The aerial duct shall be ultra-violet resistant with a minimum of 2 percent carbon black (maximum particle size of 20 mm) and possess an antioxidant.

The strands shall be 1/4 inch, extra high strength strand, ASTM A 153, Class A, galvanized with flooding compound.

Figure-8 duct shall be provided pre-lubricated with pre-installed pull-lines of 1800 pound polyester woven tape.

The aerial duct shall be installed in accordance with the manufacturer's instructions or as directed by the Engineer. The aerial duct must be installed at a final elevation of not less than 27 feet above railroad track. This final elevation shall account for the actual installed span length that shall not exceed manufacturer's maximum recommendation, with the installation elevation set to accommodate maximum allowed sag of not more than 5% of the actual installed span length at the midpoint of the span between the two attachment points.

Construction Methods:

The Contractor shall install materials in accordance with the manufacturer's instructions and as shown on the plans.

Where required for transition risers from underground to overhead construction, exposed steel conduit (rigid metal conduit) shall be secured at 4 foot intervals with 2 hole stainless steel conduit clips and screws. Stainless steel anchors shall be used on concrete walls.

Method Of Measurement:

The work will be measured per each, as applicable, complete in place and accepted.

Pole and manhole hardware work will be considered incidental to the work of this Special Provision, and will not be measured as a separate item.

Basis of Payment:

The work will be paid for at the respective contract unit price.

The cost of pole and manhole hardware work will be considered incidental to the work of this Special Provision.

The prices shall include all costs to provide for the completion of the work specified and shown on the site communications plan drawings.

Pay Item	Pay Unit
Central Communications Equipment	EA.

ITEM #1301080A – 4" DUCTILE IRON PIPE (WATER MAIN)

ITEM #1301081A – 6" DUCTILE IRON PIPE (WATER MAIN)

ITEM #1301082A – 8" DUCTILE IRON PIPE (WATER MAIN)

ITEM #1301084A – 12" DUCTILE IRON PIPE (WATER MAIN)

Description:

This item covers installation of new ductile iron water main pipe of the diameter shown on the plans for both domestic and fire protection purposes.

Submittals:

Submit product data for pipe and fittings.

The Contractor to field verify water main profiles and crossings and submit as-built drawings at completion of job.

Quality Assurance:

Comply with requirements of Regional Water Authority for all water main installations.

Materials:

All materials shall meet requirements of the FM Global Insurance and shall get Insurance and Designer approval and shall be manufactured by one of the following: Tyler Pipe Co Div of McWane Inc, EBAA Iron Inc or Victaulic Company or other Insurance and Designer approved equal.

Ductile Iron Pipe

Water pipe shall be ductile iron cement lined designed in accordance with ANS21.50/AWWA C150-96 and manufactured in accordance with ANS A21.51/AWWA C151-96.

Ductile iron pipe shall be special thickness Class 52 for diameters 16 inches or less. Pipe classified according to pressure classes designated under AWWA C150/A21.50-96 such as 250 or 350 is not acceptable.

Pipes shall be double cement-mortar lined in accordance with ANS A21.4/AWWA C104-95.

All pipe shall be push-on joint conforming to ANS A21.11/AWWA C111 latest version. Pipe shall be delivered in 18-foot lengths.

Push-on joints shall be provided with sufficient quantities of accessories conforming to ANS A21.11/AWWA C111.

Couplings

When connecting ductile iron pipe to cast iron pipe the Contractor shall use sleeve couplings. When connecting ductile iron pipe to ductile iron pipe the Contractor shall use solid sleeve mechanical joint fittings manufactured in accordance with these specifications.

Sleeve couplings and accessories shall be pressure rated for a minimum of 150 PSI. Couplings shall be ductile iron or steel. The couplings shall be provided with "Cor-Ten" (ASTM A588) bolts and nuts or approved equal.

After assembly, all surfaces of the bolts and nuts shall be thoroughly coated with two coats of an asphaltic coating. The interior and exterior of the coupling shall be epoxy-coated.

Gaskets shall properly match bell configuration. Push on joint gaskets shall be molded SBR rubber per ANSI/AWWA C111/A21.11 and ISO 4633.

Fittings

The Contractor shall furnish and install all the required fittings shown on the plans or as directed by the Designer. All fittings shall be ASTM A-536 ductile iron, cement-lined, mechanical joint. All fittings between 3-inches and48-inches in diameter shall meet or exceed the requirements of AWWA C-110. Compact fittings shall be ductile iron meeting or exceeding the requirements of AWWA C-153. Compact fittings shall only be used in sizes between 4 inches and 24 inches.

All fittings 4 inches to 24 inches shall be pressure rated at 350 PSI working pressure. Fittings shall conform to the weights, excluding accessories, and dimensions shown in the latest edition of the Handbook of Ductile Iron Pipe and come complete with all joint accessories as required. All accessories (gland, gaskets, T-bolts and nuts) shall be in accordance with AWWA C-111. All mechanical joint bolts (T-bolts) shall be “Cor-Ten” (ASTM A588) or approved equal.

Gaskets shall properly match bell configuration. Push on joint gaskets shall be molded SBR rubber per ANSI/AWWA C111/A21.11 and ISO 4633.

Warning Tape

Provide warning tape on rolls, 6 inch minimum width, color coded in **blue** (for water systems) with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification shall read, "CAUTION, BURIED WATER LINE BELOW" or similar wording. Color and printing shall be permanent, unaffected by moisture or soil.

The warning tape shall be acid and alkali-resistant polyethylene plastic tape with a minimum tape thickness of 0.003 inches. Tape shall have a minimum strength of 1500 psi lengthwise, and 1250 psi crosswise, with a maximum 350 percent elongation.

Pipe Insulation

Pipe insulation shall be exterior grade, wrapped with a waterproof jacket. The insulation shall be at least 2 inches in thickness. Insulation shall be designed for buried applications and shall be fiberglass, cellular glass, expanded polystyrene, or urethane and shall be covered with a waterproof jacket.

1. Fiberglass insulation shall conform to ASTM C553.
2. Cellular glass insulation shall conform to ASTM C552.
3. Expanded polystyrene insulation shall conform to ASTM C578.
4. Urethane insulation shall conform to ASTM C591.

Shallow Depth Protection Materials

Concrete shall be 4000 psi, 3/4” aggregate in accordance with Section 6.01. Concrete shall be colored **red**.

Welded Wire Fabric shall be 6-inches by 6-inches No. 10 gage in accordance with ASTM A185.

Steel plates shall be galvanized.

Waterstops

Waterstops within each trench spaced every 100’ are required and shall be Concrete Class “C” with no reinforcing.

Construction Methods:

Confirmation of Existing Conditions**:**

Prior to the start of construction, the Contractor shall excavate test pits to locate the existing water main at the locations where the new piping will connect to existing. Verify the location and depth of the existing mains where applicable or as directed by the Designer.

Handling Material:

Care shall be taken in loading, transporting, and unloading to prevent injury to the pipes or coatings. Pipes or fittings shall not be dropped.

Pipes and fittings shall be subjected to a careful inspection before installation. All defective pipes and fittings shall be removed from the site at no cost to the Department. If any portion of a pipe is cracked or defective the entire length shall be removed.

General**:**

Shape trench bottoms to give uniform circumferential support to the full length of each section of pipe.

Unless otherwise indicated on the plans, water pipe shall be installed with a minimum of 4-feet 6-inches of cover below finish grade.

All pipes and fittings shall be thoroughly cleaned before laying and shall be kept clean until operational. Each pipe shall be cleared of all excess tar, debris, dirt, etc., before laying.

Push-on joints shall be made up by first inserting the gasket into the groove of the bell and applying a thin film of non-toxic gasket lubricant uniformly over the inner surface. The chamfered end of the plain pipe shall be inserted into the gasket and forced past it until it seats against the bottom of the socket.

When cutting pipe is required, the cutting shall be done by machine leaving a smooth cut at right angles to the axis of the pipe. Cut ends of pipe shall be beveled to conform to the manufactured spigot end. Cement lining shall be undamaged.

Whenever encountered within the trench, existing utilities, including those not shown on the plans, shall be supported.

Ductile iron pipe and fittings shall be installed in accordance with the requirements of AWWA Standard Specification C600, except as otherwise noted herein. A firm, even bearing throughout the length of the pipe shall be constructed by tamping selected material at the sides of the pipe up to the springline. Blocking will not be permitted.

When construction is not in progress, including lunchtime; the open ends of the pipe shall be closed by watertight plug or other approved means. The Contractor shall keep the trench free from water while the pipe is being installed.

Whenever the pipes require cutting, an approved saw, wheel or hydraulic type cutter shall be used. This work shall be done by the Contractor without extra compensation, in a manner satisfactory to the Designer, and only experienced workers shall be engaged thereon.

Fittings, in addition to those shown on the plans, shall be provided, if required, for crossing utilities, which may be encountered.

All bends shall be installed with joint restraint gaskets to restrain the bend to the pipe. Additional joint restraint gaskets will be required in each direction from the bend as indicated in Table 1.

Table 1
Number of Restrained Joints, Restrained Joint Lengths (in feet)
100 psi, Cohesive Granular Soils, 18 Foot Pipe Lengths

Fitting Type Pipe Size	90 Degree	45 Degree	22.5 Degree	11.25 Degree
4”	0,11’	0,5’	0,2’	0,1’
6”	0,11’	0,5’	0,2’	0,1’
8”	0,14’	0,6’	0,3’	0,1’
12”	1,21’	0,9’	0,4’	0,2’

0,2’ = 0 joints on either side of fitting, 2 feet on either side of fitting must be restrained
1,21’ = 1 joint on either side of the fitting, 21 feet on either side of the fitting must be restrained.

Calculations for pressures greater than 100 psi or for other soil types will be performed by the Designer.

Installation of short pieces on either side of a fitting will not be permitted.

Thrust Restraint: Provide thrust restraint at joints using “Mega-lugs” or Insurance and Designer approved equal. The use of concrete thrust blocks shall be only as shown on the plans or at the direction of the Designer.
Continuity of Services**:** Do not interrupt existing services without Designer’s approval. Schedule interruptions in advance, according to Designer's instructions. Submit, request for interruption with methods proposed to minimize length of interruption, in writing. Interruptions shall be scheduled at such times of day and work to minimize impact on rail operations. Provide 72 hours notice to ConnDOT Rail Operations and Metro North Railroad prior to any interruption to service to rail yard facilities.

Separation of Potable Water Mains and Sewer Lines

Parallel Installation:

1. Water mains shall be laid at least 10 feet horizontally from any existing or proposed sewer or non-potable line. The distance shall be measured edge to edge. In cases where it is not practical to maintain a ten-foot separation, it is permissible to install a water main closer to a sewer, provided that the water main is laid in a separate trench or on an undisturbed earth shelf located on one side of the sewer at such an elevation that the bottom of the water main is at least 18 inches above the top of the sewer.

Crossings:

1. Water mains crossing sewers shall be laid to provide a minimum vertical distance of 18 inches between the outside of the water main and the outside of the sewer. The water main shall cross over the sewer. At crossings, one full length of water pipe shall be located so both joints will be as far from the sewer as possible.

When it is impossible to obtain the horizontal and vertical separation specified, construct both the water main and the sewer or non-potable line with restrained joint cement lined ductile iron pipe.

Testing**:**

1. The underground pipe lines shall be flushed and hydrostatically tested for strength and leakage in accordance with FM Global Property Loss Prevention Data Sheet 3-10 Installation and Maintenance of Private Service Mains and Their Appurtenances by the Contractor. FM Global shall be notified at least two weeks in advance of planned testing. Underground mains shall be completed and submitted to FM Global to verify proper testing. The tests for leakage shall last for at least one hour and may be required to last 2 hours. The additional water needed to maintain the required pressure shall be accurately measured in a manner approved by the Designer. The Designer shall be notified 48 hours in advance of testing and will be present during testing.

2. Leakage: The maximum allowable leakage for pipelines shall be according to the following formula:

$$L = S \times D \times P^{1/2} / 148{,}000$$

where:

L = leakage (gallons per hour)

S = length (feet), the lessor of the actual length being tested or the maximum length for determining leakage. Maximum length for determining leakage is 2000 feet.
D = pipe diameter (inches)
P = test pressure (psi)

3. The Contractor shall repair all leaks discovered under any of the required tests at no additional cost to the Department. The Contractor shall furnish all apparatus, material and labor necessary for making the tests.

4. The Contractor shall make all necessary arrangements for testing equipment and providing the water for test purposes and shall pay the expense of these arrangements.

5. The Contractor shall dispose of the test water to the site sewer system. Do not discharge to any combined sewer overflow (i.e., the 66-inch brick conduit or the twin box culvert).

6. Submit test reports to the Designer.

7. A Contractor's Material and Test Certificate (FM form 85-B) for the underground water main should be completed and submitted to FM Global

Disinfection:

1. Upon completion of the pipe line and the strength and leakage testing, the interior of the pipe shall be flushed and then disinfected in all parts. Water supply control (gate) valves installed shall be in the full open position during flushing procedures. Water mains shall be flushed for a minimum of five (5) minutes after water flows clear and free of visible obstructions. The disinfection shall result in eliminating from the new pipe line all evidence of contamination, as determined by tests of the bacterial content of samples of water taken from the new water main. The disinfection may be accomplished by introducing into all the various parts of the new water mains a liquid solution containing one percent available chlorine in such volume that the rate of dosage of the water mains shall be at least 50 parts per million of available chlorine. The contact period for this disinfection shall be at least 24 hours, and a longer period will be required if tests of water samples residual chlorine levels show it to be necessary for proper disinfection.

2. The Contractor shall furnish and install suitable interim testing plugs, caps, pumps, pipe connections and other appurtenances as necessary and all labor required for testing bacteria and disinfecting the water mains.

3. Any temporary equipment or materials needed to flush underground mains shall be provided during construction and capable of handling the required water flows. Flushing shall be conducted as follows:

Pipe Size	Minimum Flow Rate (GPM)
4”	400
6”	900
8”	1,560
12”	3,520

4. The Contractor shall dispose of the test water to the site sanitary sewer system.

5. The water system shall be flushed out after its disinfection.

6. All work shall be done in accordance with AWWA C601.

7. Connections at cuttings shall be swabbed with 50 PPM solution of chlorine at locations when other methods are not applicable.

8. Provide one week notice to the Designer prior to performing disinfection.

Underground Utility Marking**:** underground utility marking tape shall be set one foot 6 inches above, and running parallel with the horizontal projection of the centerline of the completed pipe. Pipe Insulation: Where new water pipe has less than 4 feet 6 inches of cover beneath finish grade, the pipe shall be individually insulated. Insulation shall be installed in accordance with the manufacturer’s recommendations. The insulation shall be covered with a waterproof coating.

Shallow Depth Protection: Where new water pipe has less than 4 feet 6 inches of cover beneath finish grade, install shallow depth protection over the pipe as indicated on the plans. Install at least 3 inches of compressible material over the pipe and insulation before pouring the concrete for the shallow depth protection. Install the steel plates on top of the shallow depth protection.

Waterstops: Place concrete waterstop full width of trench from bottom of trench to 12” above pipe every 100’ or as directed by the Engineer. A minimum width of 6” is required for each waterstop.

Method of Measurement:

Ductile iron water pipe will be measured for payment per linear foot, completed and accepted.

Basis of Payment:

Ductile iron water pipe will be paid for at the contract unit price per linear foot, complete in place, including all materials, equipment, testing, tools and labor incidental thereto. Payment shall include full compensation for furnishing and installing pipe, fittings, couplings, insulation, waterstops, and shallow depth protection where required.

Trench Excavation, Rock-In-Trench Excavation and Bedding Material shall be paid for separately under the applicable item.

Pay Item	**Pay Unit**
4” Ductile Iron Pipe (Water Main)	L. F.
6” Ductile Iron Pipe (Water Main)	L. F.
8” Ductile Iron Pipe (Water Main)	L. F.
12” Ductile Iron Pipe (Water Main)	L. F.

ITEM #1302002A – 4” GATE VALVE

ITEM #1302004A – 8” GATE VALVE

ITEM #1302006A – 12” GATE VALVE

Description:

This specification identifies the requirements for the manufacture and installation of gate valve assemblies. The work shall include the fabrication and installation of the complete assemblies including gate valves, valve boxes and covers, anchors and, concrete blocking as directed by the Designer.

Materials:

Gate valves, unless otherwise indicated, shall be the same size as the main in which they are installed. All gate valves shall be non-rising stem, counter-clockwise opening and provided with a 2-inch square operating nut with the word open and an arrow cast in the metal to indicate direction to open. Valves shall be marked with raised lettering cast on the body indicating manufacturer and working pressure. Working pressure rating shall equal or exceed that of the pressure class of the adjoining pipe unless otherwise indicated.

Valves shall be provided with a flanged-by-mechanical joint end with the mechanical joint end designed for connection to cast iron.

Provide adaptor to join tapping machine to mechanical joint end. Gaskets shall conform to AWWA C111 and be full faced 1/16-inch cloth inserted rubber with bolt holes pre-punched.

Valves shall conform to AWWA C509 and shall be iron body, fully-encapsulated resilient wedge type with solid bronze stem and disc nut. The minimum designated water working pressure shall be 200 psi for valves four inches through twelve inches and 150 psi for larger valves.

Coat the exterior surfaces at the place of manufacture. Coating shall be a minimum of 6 mils thick epoxy, compliant with AWWA 550 and certified to NSF 61.

Bolts and nuts used for bolting flanged gate valves above ground shall be square head Machine bolts and hexagonal nuts conforming to ASTM A307 and ASTM A 563, respectively; Grade B. All bolts and nuts for buried flanged gate valves shall be per ASTM F 593 and ASTM F 594, respectively; Alloy Group 2, Condition CW1/CW2 (depending on size).

Where the depth of the valve is such that its centerline is more than four feet below grade, provide operating extension stems to bring the operating nut to a point 6 inches below the surface

of the ground and/or box cover. Extension stems shall be steel and shall be complete with 2-inch square operating nut.

Valve boxes shall consist of Schedule 40 steel pipe with valve box cover. Covers shall be marked "water" (cast in original mold) and shall be as shown in on the plans.

Class “C” Concrete as specified in Section M.03.01 shall be used for concrete blocking, as directed by the Designer.

Construction Methods:

Check operation of all valves before installing.

Install valves per accepted manufacturer's written instructions and the requirements of AWWA C500. All bolt threads shall be lubricated with graphite and oil prior to installation.

Install support blocking as shown on the plans.

Valve box covers shall be seated flush with the surface of the proposed ground or paved surface. Covers located in areas surfaced or to be surfaced with asphalt or concrete shall be set in a 24-inch diameter x 6-inch thick concrete ring. The concrete ring shall be omitted in other locations.

Valves shall be tested prior to installation. Approval by Designer must be obtained prior to backfilling.

Anchors and concrete blocking, as required, shall be constructed in locations as directed by the Designer.

Method of Measurement:

The installation of gate valves pipe as shown on the Contract Drawings or directed by the Designer will be measured for payment as a unit.

Basis of Payment:

This work will be paid for at the contract unit price each for "Gate Valve” (Any Size) as called for on the Plan, complete in place, which price shall include the cost of the valve, valve box, anchors, concrete blocking, and all incidental work.

Pay Item	**Pay Unit**
4” Gate Valve	EA.
8” Gate Valve	EA.

12” Gate Valve EA.

ITEM #1400101A - 6” POLYVINYL CHLORIDE PIPE (SANITARY SEWER)

ITEM #1400102A - 8” POLYVINYL CHLORIDE PIPE (SANITARY SEWER)

ITEM #1400103A - 10” POLYVINYL CHLORIDE PIPE (SANITARY SEWER)

Description:

The sizes, types and slopes of pipe are indicated on the Contract Drawings, which requirements as to pipe size, type, slope, etc., shall be observed. The types of pipe, which shall be used for various parts of the work as indicated above, shall be as follows:

a. Gravity Sanitary Sewer Pipe shall be polyvinyl chloride pipe. All pipe to be used shall be subject to approval by the Designer.

This work shall also include the satisfactory testing of the gravity pipe, the backfilling of the casing pipe annular space and the maintenance of existing wastewater flows during the installation of the new work.

Materials:

a. Polyvinyl Chloride Pipe (PVC): This pipe and fittings shall be suitable for non-pressure drainage of sewage, certain other liquid wastes, were toughness, resistance to deterioration from the action of water and chemicals, dimensional stability, resistance to aging and tight joints are required. Pipe shall conform to the latest ASTM Standard Specifications D3034, Type PSM SDR-35 or ASTM F-679 for pipe over 15 inch diameter.

   The pipe and fitting shall be made from Virgin Type 1 Grade 1, Polyvinyl Chloride compounds *as* defined and described in ASTM Specification D-1784 for "Rigid Poly (Vinyl Chloride) Compounds and Chlorinated Poly (Vinyl Chloride) Compounds.

   Clean rework material, generated from the manufacturer's own pipe or fitting production may be used by the same manufacturer provided the pipe and fittings so produced meet the requirements of this specification.

Physical and Chemical Properties - The physical and chemical properties shall conform to those minimums specified for Type 1, Grade 1 Polyvinyl Chloride compound designated in ASTM Specification D-1784 noted above.

Dimensions – The standard length of pipe provided under this specification shall be a minimum of 10 feet, except that all pipe used in house connections and/or laterals shall not exceed 6 feet in length unless otherwise approved by the Designer.

The pipe shall be manufactured to the following dimensions:

Nominal Size	Minimum Wall Thickness
6	1/5”
8	1/4”
10	1/3”

All dimensions in inches.

Fittings shall be made in sizes and to the dimensions of standard pipe as above. If dimensions, structural design or materials from which they are manufactured vary from other provisions of this specification, it shall be done so with the approval of the Designer.

Joints shall be the bell and spigot type. Joints (ASTM D3212) shall be sealed with a nitrile "0" ring gasket, conforming to ASTM Designation D3034 or approved by the Designer, and shall be of a composition and texture which is resistant to common ingredients of sewage, industrial wastes including oils and ground water, and which will endure permanently under the conditions likely to be imposed by this use.

The tensile strength shall be at least 1300 psi. The elongation at rupture shall be such that 2 inch gauge marks shall stretch to not less than 10 inch. Hardness shall be between 40 and 50, *as* measured with a Shore Durometer. The compression set (constant deflection) shall not exceed 25 percent of the original deflection.

The tensile strength after accelerated aging shall be not less than 80 percent of the original strength. The joint, when assembled, must be able to withstand a hydraulic pressure internally of at least 25 psi.

Fittings: Wyes, Tees, Bends and adapters, and any other fittings required by the Designer shall be provided. Plans for such fittings showing cross sectional views with dimensions shall be provided, and the Designer prior to their use shall approve such plans and fittings. The materials used in the manufacture of fittings shall conform to the requirements for the Pipe with which they shall be used and any variation of such requirements shall be subject to approval of the Designer.

Testing: Pipe shall be tested when requested by the Designer, and all sizes of pipe so designated shall be tested as follows:

Pipe shall be tested in accordance with ASTM D-2412 Standard Method of Test for External Loading Properties of Plastic Pipe by Parallel-Plate Loading." The minimum value of Pipe Stiffness at 5% deflection computed from data obtained from the above testing procedure shall be as indicated in Table 1.

TABLE I
MINIMUM VALUE OF PIPE STIFFNESS AT 5% DEFLECTION

NOMINAL PIPE SIZE	PIPE STIFFNESS
6 inch	46psi
8 inch	46psi
10 inch	46psi

Marking - Pipe shall be marked along the outside of the barrel in bold style type and shall indicate the manufacturer's name, pipe size, PVC compound used, i.e., PVC Type 1 Grade 1 and the ASTM material specification for the PVC compound used, i.e., ASTM D1784.

Workmanship - The pipe and fittings shall be homogeneous throughout and free from visible cracks, holes, foreign inclusions or other injurious defects. The pipe shall be as uniform as commercially practical in color, opacity, density and other physical properties.

Waterstops - The manufacturer shall provide waterstops, acceptable to the Designer, which shall be applied to the outside of plastic pipe when the pipe is to be enclosed in any structure where concrete or mortar is used which will prevent leakage along the outer wall of the barrel of the pipe.

Waterstops within each trench greater than 100’ in length between structures are required and shall be Concrete Class “C” with no reinforcing.

Flexible Couplings - As required shall be manufactured by Femco, Inc. Davison, Michigan or approved equal.

Construction:

LAYING SEWER PIPE:

Sewer pipe, both in main sewer, laterals or connections, shall be of the sizes, type, materials, etc., indicated by the contract documents; all pipe shall be laid, supported, jointed, tested and backfilled as indicated or required for the particular job, location, or condition by

drawings or other contract documents. All pipes when in place shall be precisely true to the line and grade indicated therefore by the Designer, sound, well laid, jointed and bedded and free from defects. Any pipe discovered to be defective after having been laid shall be removed and replaced by a sound and satisfactory piece.

All pipes in main sewer lines will, in general, be laid using a laser. String line will only be allowed with the approval of the Designer. All pipe in main sewer lines laid using a grade string are to be stretched out above the line of pipe between batter boards of profiles averaging twenty three feet and not exceeding thirty feet apart and by measuring down to the bed for each pipe prior to setting it in place, and to the end of each pipe, when it has been placed, by means of a suitable grade pole, and brought to line with a plumb bob, all of which tools shall be furnished by the Contractor and satisfactory to the Designer.

Filter Fabric: The Contractor shall furnish and install new filter fabric along the length of the sewer pipe. The fabric is to be placed over the pipe, between the crushed stone bedding and the bank run gravel backfill. The filter fabric shall be a non-woven type with a minimum grab tensile strength of 122 pound and a minimum Mullen burst strength of 198 pound. The fabric shall be of sufficient width so as to form one continuous liner along the trench width with six inch minimum overlap along the trench length.

Bedding: Pipes, in general, shall be bedded in crushed stone or screened gravel or as otherwise directed by the Designer in accordance with the contract drawings and as described in of these specifications.

Filling Around Pipe: Immediately after pipe has been laid, set to line and grade; crushed stone shall be placed carefully on the sides and top of pipe as detailed and as directed by the Designer.

No walking on or working over pipes after they are laid except as may be necessary in making joints, in placing cradles, and in tamping backfill material will be permitted until pipes are covered with earth to a depth of 18 inches. During construction, all openings to pipe lines shall be protected from entrance of earth or other material. Open ends of branches and pipes when completed shall be sealed with stoppers, or by equally effective methods. Where new pipes are to join existing ones, the Contractor shall do such work *as* necessary to make connections.

The Designer reserves the right to cause the Contractor to place a plumber's plug in the sewer line as it enters the existing sewer system and to leave it until the job is complete and after completion, shall clean and flush the new sewer as directed by the Designer.

Protection of Water Supplies: Wherever sewers cross under water mains, a separating distance of 18 inch or more shall be maintained between crown of sewer and bottom water main. Whenever this distance cannot be maintained, the Contractor shall advise the Designer and await further instructions before proceeding with crossing of water main. Whenever

horizontal separation is less than 10 feet between sewer line and water main, the above mentioned 18 inch separating distance shall also apply, and the Contractor shall advise Designer as previously instructed.

The whole of the lateral trench shall be dug to the required grade before any pipe is laid therein; and the pipe shall be laid closely to line and grade, using a grade line, hand level, or straight edge as may be ordered. House connection laterals will generally be laid at right angles to the main sewer, from wye branches by means of bends of approved form, or from inlets built into other sewers. The Contractor shall take proper means for his own use to temporarily locate all wyes, etc., in main sewer before connections are laid, and will be responsible for finding wyes, etc., from which he is to lay connections or laterals.

Extra care shall be taken to make smooth, close-fitting joints at all bends. Pipes shall be trimmed or extra bends used when ordered to accomplish this, without extra charge. So far *as* possible, every joint shall be swabbed out inside after being made. All requirements for laying pipe of this size, as described elsewhere herein, shall be observed inlaying connection laterals, so far as those requirements apply. The end shall be closed with a vitrified cover caulked in with a cap or oakum, lightly cemented, and allowed to set before being placed in the trench or as otherwise directed.

A stout stake to mark the location and elevation of the end of each lateral will be driven *as* directed by the Designer near the end of each lateral. This stake will be protected and maintained undisturbed until the Designer has completed all his measurements and if so ordered, will thereafter be removed by the Contractor.

Except where otherwise indicated or ordered, house connection laterals will be 6 inches in diameter. If pipe larger than 6 inch is ordered in *a* lateral or connection, where such larger size had not previously been indicated and where will be paid the additional cost of the larger size pipe over and above what would have been the cost of equivalent 6 inch size.

Branches: All wye branches, T-branches, slants, inlet pipe, etc., shall be furnished and set as indicated by drawings or as directed by the Designer. Since many times the number of branches to be required on their locations cannot be fully determined in advance, the Designer may determine, as the work progresses, the number to be furnished and set, and where they should be located. Branches set by the Contractor solely for his own convenience for temporary connections or temporary drainage, even if set with the permission and approval of the Designer, will not be paid for.

Markers At Branches: If directed by the Designer, a piece of lumber, not less than 2 inch x 4 inch, will be set vertically and left in place, extending from a point directly in front of but not contact with the outer end of a capped wye, etc., or connection lateral from said pipe up to a point about four feet below the ground surface or finished street grade to guide persons who in future years may have occasion to excavate to find the wye or connection, etc., and to protect the end of the wye, etc., from damage when making such excavation.

Pipe Straightness - No single piece of pipe shall be laid on any project covered by these specifications unless it is found to be generally straight. Such pipe shall have a maximum ordinate as measured from the concave side of the pipe not to exceed 1/16 inches per foot of length. If the deviation from straightness exceeds this requirement then the particular piece of pipe shall be rejected for use until it can comply with this provision.

Installation:

Polyvinyl Chloride Pipe (PVC) shall be installed in accordance with ASTM Standard Recommended Practice D-2321 for underground installation of flexible thermoplastic sewer Pipe.

The Contractor shall remove by pumping, draining, bailing or otherwise, any water which may accumulate or be found in trenches where PVC Pipe is to be installed.

The PVC Pipe shall be laid on a 6 inch crushed stone base and backfilled with crushed stone to 6 inch above the top of pipe. No sand backfill shall be required above the pipe. The backfill above the crushed stone shall be either approved excavated material or bank run gravel, as determined by the Designer.

Upon completion of installation, the Contractor shall provide certified air tests, as directed by the Designer, on all pipe installed under this Contract.

LEAKAGE TESTS AND ALLOWANCES FOR GRAVITY SEWERS:

Rate of infiltration into or leakage out of all gravity sewers and appurtenant constructions shall be tested. Suitable bulkheads, weirs or other devices shall be built by the Contractor to enable the Designer to make measurements of water tightness of sewers after their completion. Leakage tests shall be carried out in a manner approved by the Designer. The Designer will designate the tests to be performed on the basis of the ground water elevations and other physical conditions at the time tests are to be performed. The Contractor will be required to independently test manholes and pipelines. Pipelines will be tested by infiltration when ground water level is 24 inch above the crown of the upper end of the sewer, and by exfiltration when below this level. The maximum length of pipeline to be tested shall not exceed one section (manhole to manhole). The allowable leakage rate into or out of the sewer lines shall not exceed 50 gallons/inch of diameter per day per 1 mile of pipe. The allowable leakage rate out of an individual manhole shall not exceed 0.45 gallons per day per foot of depth. If the measured infiltration/exfiltration rates exceed the allowable rates, the necessary repairs shall be made by the Contractor to reduce leakage to rates stated herein, and additional tests shall be made at the Contractor's expense.

a. Infiltration Tests: The Contractor shall plug all inlets and outlets into the upstream manhole, except for the line being tested. A V-notch weir shall be placed into the upstream pipe in the downstream manhole, with a watertight seal between the weir and the pipeline. Infiltrating water shall be allowed to build up and level off behind the weir until a steady uniform flow passes over the V-notch weir. After steady flow has been established, measurements of water flow shall be taken at thirty-minute intervals, with not less than

three (3) consecutive readings. Flow measurement shall be converted to gallons per day infiltration rate.

b. Exfiltration Tests: The Contractor shall plug all inlets and outlets into upstream manhole, except for line being tested. A tapped plug shall be placed in the inlet pipe of the downstream manhole, with a water supply connection. For filling the pipeline, water shall be introduced into the pipeline at the downstream manhole until the upstream manhole has been filled to a depth of 6 feet, or 6 inch below the beginning of the manhole taper, whichever is less.

The line shall be allowed to stand full for a minimum of twenty four (24) hours before beginning exfiltration measurements. After refilling to original level, the drop in water level over the following four-hour period shall be measured and converted to gallons per day lost through pipeline exfiltration, after appropriate compensation for manhole losses.

LOW-PRESSURE AIR TEST:

The Designer may, at his option, require the Contractor to perform low-pressure air testing of the gravity sewers in lieu of infiltration or exfiltration testing on the pipelines. Water testing of manholes will be required, on order of the Designer. Where air testing is to be substituted, the Contractor will be notified sufficiently in advance to allow him to obtain and transport to the job site all necessary equipment for carrying out the air tests, which will include compressor, control panel, pneumatic plugs, hoses and cables, and all other miscellaneous accessories.

Air testing will be conducted between manholes. The sewer line under test shall be plugged at both ends. An air hose shall be connected to a tapped plug to be used for air inlet to the line. The hose will be connected to portable air control equipment, which must include a shutoff valve, pressure regulating valve, pressure reduction valve and a monitoring pressure gauge with range from 0 to 5 psi.

Air shall be introduced from the air source through the control equipment to the pipeline.

a. Introduce low pressure air into the sealed sewer pipeline until the air pressure reaches 4 psi gauge greater than the average groundwater pressure.

b. Allow a minimum of 2 minutes for the air pressure to stabilize to a minimum of 3.5 psi gauge greater than the groundwater pressure. Groundwater is assumed to be at ground surface unless the Contractor can prove by otherwise by test pitting.

c. After the stabilization period, disconnect the air hose from the control panel to the air supply.

d. The pipeline will be acceptable if the pressure decrease is not greater than 0.5 psi gauge in the time stated in the following table for the length of pipe being tested:

Time (Min.) for Length of Pipe

Pipe Diameter (mm)	0-99’	99-200’	200-300’	300-400’
4”.....	2.0	2.0	2.0	2.0
6”.....	3.0	3.0	3.0	3.0
8”.....	4.0	4.0	4.0	5.0
10”.....	5.0	5.0	6.0	8.0
12”.....	5.5	5.5	8.5	11.5
15”	7.0	8.5	13.0	17.0
18”.....	8.5	12.0	19.0	25.0
21”	10.0	17.5	26.0	35.0
24”.....	11.5	23.0	34.0	45.5
27” and larger.....	14.5	29	43.0	58.0

Test Results:

a. If the installation fails the low pressure air test, determine the source of leakage.
b. Repair or replace all defective materials and/or workmanship and repeat low-pressure air test at no additional cost to the MNRR.

Allowable Pipe Deflection - Plastic pipe provided under this specification shall be so installed in the ground that a deflection of no more than 5 percent can be anticipated. Such deflection shall be computed by dividing the amount of deflection (nominal diameter less minimum diameter when measured) by the nominal diameter of the pipe.
However, between any two adjacent manholes, the average deflection shall not exceed 6 percent and no deflection at any point in the pipe shall exceed 7.5 percent, computed in the manner described herein.
After completion of the backfill, the Engineer may require that a deflection test be performed. If the test section fails the test for excessive deflection, the contractor shall repair or replace all defective materials and/or workmanship at no additional cost to the governing authority.
Deflection tests should be conducted using a go/no-go mandrel. The mandrel’s outside dimension shall be sized to permit no more than 7.5 percent deflection. The percent deflection shall be established from the base inside diameter of the pipe. The mandrel shall be approved by the Engineer prior to use. Lines that permit safe entry may allow other deflection test options, such as direct measurements with extension rulers

Buried Utility Markings: Buried utility markings shall be installed 2 feet above the top of the buried pipeline or as directed by the Designer.

Waterstops: Place Concrete Waterstops full width of trench from bottom of trench to 12" above pipe at the midpoint of each run greater than 100' between structures or as directed by the Engineer. Forms are not required however the Contractor may utilize them to restrain the width of the stop. A minimum width of 6" is required for each stop. Waterstops are not required in trenches with less than 100' between structures.

Methods of Measurement:

This work will be measured for payment as follows:

New PVC pipe will be measured for payment by the actual number of feet of pipe of the various sizes and types, completed and accepted and measured in place along the invert.

Bedding Material will be measured as payment as specified elsewhere.

Flexible couplings, sand, filter fabric, testing, reconnection of sanitary laterals, wood cradles and all waterstops will not be measured for payment, their work to be included in other pay items.

Basis of Payment:

A. This work will be paid for as follows:

1. Payment for furnishing and installing sewer lines will be made for at the unit bid price per linear foot of the sizes indicated. The contract unit price for sewer pipe (PVC) shall be full compensation for all labor, materials, and equipment necessary to complete this work including dewatering, furnishing and installing pipe (including tees and other fittings), filter fabric, buried utility tape, making connections to new and existing manholes, connections to existing sanitary laterals, cleaning, testing, all waterstops, and all else incidental thereto for which payment is not provided under other items.

2. Payment shall also include protection of existing utilities, coring holes for pipes in existing manholes and rebuilding existing manhole inverts.

B. Trench Excavation, Rock-In-Trench Excavation and bedding material shall be paid for separately under the applicable item.

Pay Item	**Pay Unit**
6" Polyvinyl Chloride Pipe (Sanitary Sewer)	L.F.

8” Polyvinyl Chloride Pipe (Sanitary Sewer)	L.F.
10” Polyvinyl Chloride Pipe (Sanitary Sewer)	L.F.

ITEM #1403001A - MANHOLE (SANITARY SEWER)

Description:

This work shall include the furnishing and installation of sanitary manholes of the size and to the elevations as indicated on the plans as specified herein, in accordance with appropriate parts of Section 2.05 and Section 5.07 of the Standard Specifications for Roads, Bridges and Incidental Construction Form 816 and as directed by the Designer.

Materials:

A. Manholes

All manholes shall be precast and completely watertight, including frame and cover. Precast concrete manholes shall conform to the details of construction and installation indicated on the Plans. Bases shall have a monolithic base slab with riser barrel meeting ASTM C478 and AASHTO M199 and designed for Cooper E-80 loading. All structures shall be designed to accommodate loading applied at a distance of 4'-3" from the centerline of track.

No. 6 Crushed Stone shall conform to the requirements of Section 7.28.

Pipes shall be connected to the manhole walls using an approved cast in flexible watertight connector. Connectors shall be manufactured by Press-Seal Gasket Corporation or approved equal and conform to ASTM C990.

B. Manhole Steps, Manhole Frames, Covers and Drop inlets

Manhole steps, frames, covers and drop inlets shall conform to standards as shown on the Plans. Steps shall be of extruded aluminum or cast iron. Frames and covers shall be of tough, gray cast iron. Castings shall be true to pattern and free from flaws. Bearing surfaces of manhole frames and covers against each other shall be machined to give continuous contact throughout their entire circumference. All iron castings shall be thoroughly cleaned and then coated with hot coal tar before being delivered. Embedded portions of aluminum steps shall also be heavily coated with bituminous material before being cast into concrete.

C. Submittals:

Precast manholes shall be designed by a Connecticut Licensed Professional Engineer. Contractor shall submit stamped shop drawings and calculations to the Engineer for approval.

Construction Methods:

All manholes shall be installed to the elevations and locations as indicated on the Plans and as directed by the Designer. Place the Precast base units on a bedding material base with a thickness least 12 inches after compaction or of greater thickness and compaction if specified elsewhere. The sub base shall be check for level prior to setting.

Top Slabs shall have a minimum thickness of 8" and conform to ASTM C478 and designed for Cooper E-80 loading applied at a distance of 4'-3" from the centerline of track. Install tops according the Drawings at finished grade. Adjust to grade with pre-approved 3" precast grade rings.

Invert channels will be smooth and semicircular in shape conforming to the inside of the adjacent sewer section. Make changes in the direction of flow with smooth curves having a radius as large as permitted by the size of the manhole. Terminate the pipes at the inside face of the manhole where changes of direction occur. Shape invert to make smooth transition in vertical grade. Slope the floor of the manhole to the flow channel, as shown on the Plans.

Set all frames in a full bed of mortar, true to grade and concentric with the manhole opening. Completely fill all voids beneath the bottom flange to make a watertight fit. Place a ring of mortar at least ½" thick around the outside of the bottom flange, extending to the outer edge of the manhole all around its circumference. Clean the frame seats before setting the covers in place.

Exterior surfaces of manholes shall have two coats of an approved asphalt coating applied according to manufactures recommendations. An alternate to the exterior coating shall be a concrete admixture that is applied to the concrete with batching and demonstrates a reduction in water absorption below five percent..

Thoroughly clean all manholes, steps, frames and covers of all debris and foreign matter.

Testing:

Provide all equipment and personnel necessary, and make all tests required to demonstrate tint the work of this section has been completed in strict accordance with the design and the specified requirements. All units shall be inspected to be sound. There shall be no visible leakage through the walls or pipe connections.

Manholes shall be tested for infiltration or exfiltration as outlined in the Sanitary Sewer Special Provisions.

Testing on Sanitary Precast Concrete Manholes shall be by Vacuum Testing in accordance with ASTM C 1244. All vacuum testing shall be preformed prior to backfilling of manhole. The test procedure shall be as follows:

1. Plug, seal, and brace all pipes entering the manhole to prevent them from dislodging during the test. Pipe plugs shall be installed beyond boot seals.

2. Firmly secure vacuum testing equipment to manhole as per recommendations.

3. Start vacuum and seal and necessary leaks around the testing equipment bladder.

4. Attain a vacuum of 10” Hg.

5. Time pressure drop to 9” Hg. Record time. If time to drop 1” Hg is less than 1 minute, manhole shall be passed. If manhole does not pass, the Contractor shall locate leak(s) and repair and retest until satisfactory.

Methods of Measurement:

These items will be measured for payment by the actual number of manholes satisfactorily completed of the various sizes, types and/or depths.

Drop Inlet construction within the manhole as required will not be measured separately for payment but included in the general cost of the Manhole.

Excavation shall be measured for payment as specified elsewhere.

Basis of Payment:

This work will be paid for at the contract unit price per each manhole of the various sizes, types and/or depths that have been satisfactorily completed and tested. The price shall include all material, tools, equipment, labor, testing and incidentals thereto to complete this work described herein and as detailed on the Plans.

Trench Excavation and Rock In Trench Excavation shall be paid separately under the applicable item.

Pay Item	**Pay Unit**
Manhole (Sanitary Sewer)	EA.

ITEM #1500006A – UTILITY ADJUSTMENT (ESTIMATED COST PLUS)

Description:

This work shall consist of payment to utility companies by the Contractor for the utility company's work to install, relocate, and/or adjust certain utility facilities which are affected by the project. The Contractor is responsible to hire and coordinate with the affected utility companies to adjust their respective facilities affected by the Contract work, and to coordinate other Contract work required to facilitate the utility company's work. The utility work required in this Contract includes:

New Southern Connecticut Gas Company (SCGC) gas service is required to the new IWT building and the gas-fired emergency generator serving the building. Also required is the relocation of the gas feed to the existing wheel mill due to conflicts between the existing gas feed and the new storm drainage system.

A new sanitary sewer service connection is required for the IWT Building. The contractor will be required to file a new service connection permit with Greater New Haven Water Pollution Control Authority (GNHWPCA). In addition to the permit, the contractor will also be required to pay a one time sewer connection fee to the GNHWPCA, which is based on the size of the water service piping to the building. These permit and fee requirements must be satisfied prior to the GNHWPCA performing any inspection services.

This work shall include coordination with SCGC, GNHWPCA, Metro-North Railroad (MNRR), and ConnDOT, for installing the service connection from existing SCGC and GNHWPCA infrastructures to the new facilities within the rail yard. Any damage caused by the Contractor or Subcontractors, as determined by the Engineer, shall be corrected by the Contractor in accordance with this specification.

The Contractor shall coordinate Contract work required in support of the utility company's work, such as trenching and backfilling, conduit or pole installation, duct bank or concrete pad installation.

Materials:

All materials shall be provided by the Contractor, unless otherwise provided by SCGC or the GNHWPCA, and shall meet the current standards of the affected service.

Construction Methods:

The SCGC work under this specification shall be performed only by the affected utility company who owns the facilities being relocated or connected to, or by the utility company's authorized subcontractor. The contractor shall coordinate all work performed by the utility company with

facility occupants, affected adjacent property owners, and ConnDOT, and as directed by the Engineer. Certain work may require use of a licensed and/or certified tradesman when such work is required by local and/or state codes.

The contractor is responsible for all work related to the new sanitary sewer connection. The contractor shall coordinate all sanitary sewer work with the GNHWCA, affected adjacent property owners, and ConnDOT, and as directed by the Engineer. Certain work may require use of a licensed and/or certified tradesman when such work is required by local and/or state codes.

Any of the affected utility, or other utility customer's service interruption shall be done in a way that minimizes adverse impacts to the customer and affected utility.

Any labor, materials, and equipment supplied by the affected utility, or other utility companies shall be on a billable basis to the Contractor.

Method of Measurement

The item "Utility Adjustment (Estimated Cost Plus)", will be measured for payment based on the actual work completed.

Basis of Payment:

The sum of money shown on the estimate and in the itemized proposal as "Estimated Cost Plus" for this work will be considered the price bid even though payment will be made only for actual work performed. The estimated cost figure is not to be altered in any manner by the bidder. Should the bidder alter the amount shown, the altered figure will be disregarded and the original price will be used to determine the total amount for the contract.

The item "Utility Adjustment (Estimated Cost Plus)", will be paid for as outlined under Article 1.09.04 of the Form 816 – Extra and Cost-Plus work.

Payment will include all equipment, materials and labor associated with this item.

Corrective work required to repair damage caused by the Contractor or its Subcontractors shall not be measured for payment.

Pay Item	Pay Unit
Utility Adjustment (Estimated Cost Plus)	Estpls

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Contractor shall coordinate work with that of other trades affecting or affected by the work included under this Section and shall cooperate with such trades, the Inspecting Agency, the Designer and the Department to assure the steady and timely progress of the work.

B. The Contractor agrees to accept the results of any tests secured by a qualified Testing Laboratory.

C. Where referred to, Standard Specifications of technical societies, manufacturer's associations and federal agencies shall be the latest edition, unless noted otherwise by Connecticut Building Code, and include all amendments current as of the date of issue of these Specifications.

1.2 SUMMARY

A. Provide all materials and labor necessary to complete all concrete, plain and reinforced as indicated on the Plans or called out for in these specifications and as required to complete the Project. Work included, without limiting the generality thereof, consists of:

1. The installation of all elements including cast-in-place concrete walls, base slabs, foundations, footings, tie beams, and slabs.

2. The installation of trenches, pits, electrical and telephone ductbanks, and other incidental concrete work.

3. Work of architectural and other trades required to be built into the concrete, such as inserts, anchors, embedded plates, under slab conduit or utility supports and reinforcing dowels.

4. Encasement of steel columns as indicated on Structural and Architectural plans to provide for fireproofing and protection from impact.

5. All forms, staging, bracing and other materials and equipment necessary and required to produce the concrete in place and for removal of same.

6. Installation of reinforcing steel, including accessories and supports, anchor bolts, leveling plates and other embedded items.

7. Finishing of concrete as specified herein or as indicated on Plans.

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. Carefully examine all of the Contract Documents for requirements which affect the work of this section.

1. Carefully review all of the Contract Documents for anchor bolts, inserts, conduits, sleeves, anchors, and all other items which must be cast into concrete construction.

2. Items needed to be embedded in concrete work may or may not be described in detail and must be determined through careful coordination of all subcontractors and building trades.

B. Other specifications sections which directly relate to the work of this section include, but are not limited to, the following:

1. Item #0702396A, “Driving Prestressed Concrete Piles”
2. Section 03 45 00 - Architectural Precast Concrete
3. Section 03 54 00 - Trowelable and Self-Leveling Concrete Underlayment
4. Section 05 50 00 - Metal Fabrications
5. Section 07 14 00 - Fluid Applied Waterproofing
6. Section 07 14 16 - Cold Fluid-Applied Waterproofing
7. Section 07 19 00 - Water Repellent Penetrating Sealer
8. Section 07 92 00 - Joint Sealants.

1.4 QUALITY ASSURANCE

A. Codes and Standards: Comply with provisions of following codes, specifications and standards, except where more stringent requirements are shown or specified:

Connecticut State Building Code

1. ACI 301 "Specifications for Structural Concrete for Buildings".
2. ACI 304 "Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete".
3. ACI 305 "Recommended Practice for Hot Weather Concreting".
4. ACI 306 "Recommended Practice for Cold Weather Concreting".
5. ACI 311 "Recommended Practice for Concrete Inspection".
6. ACI 318 "Building Code Requirements for Reinforced Concrete".
7. ACI 347 "Recommended Practice for Concrete Formwork".
8. ACI 614 "Recommended Practice for Measuring, Mixing, and Placing Concrete".
9. ACI 211.1 "Recommended Practice for Selecting Proportions for Normal Weight - Concrete".
10. ASTM C31 "Making and Curing Concrete Compression and Flexural Strength Test-Specimens in the Field".
11. ASTM C39 "Test Method for Compressive Strength of Cylindrical Concrete Specimens".
12. ASTM C94 "Specifications for Ready Mixed Concrete".
13. ASTM C136 "Sieve Analysis of Fine and Coarse Aggregate".
14. ASTM C138 "Unit Weight, Yield, and Air Content of Concrete".
15. ASTM C143 "Test for Slump of Portland Cement Concrete".
16. ASTM C150 "Specification for Portland Cement".
17. ASTM C171 "Sheet Materials for Curing Concrete".
18. ASTM C172 "Sampling Fresh Concrete".
19. ASTM C231 "Test for Air Content of Freshly Mixed Concrete by the Pressure Method".
20. ASTM C260 "Specification for Air-Entraining Admixtures for Concrete".
21. ASTM C309 "Specification for Liquid Membrane Forming Compounds for Curing Concrete
22. ASTM C494 "Specification for Chemical Admixtures for Concrete".
23. ASTM C827 "Test Method for Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures
24. ASTM C989 "Specification for Ground Iron Blast-Furnace Slag for Use in Concrete and Mortars".

25. ASTM C1064 "Test Method for Temperature of Freshly Mixed Portland-Cement Concrete".
26. ASTM E154 "Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover".
27. NRMCA "Concrete Plant Standards and Truck Mixer and Agitator Standards".
28. CRSI Concrete Reinforcing Steel Institute, "Manual of Standard Practice".
29. ACI 302 "Guide For Concrete Floor and Slab Construction".
30. ACI 308 "Standard Practice For Curing Concrete".
31. ACI 315 “Details and Detailing of Concrete Reinforcement”.

B. Concrete Testing Service: The Contractor shall employ and pay an independent testing laboratory, acceptable to the Department, to perform material evaluation tests and to design concrete mixes or, when acceptable to the Department, provide copies of recently made material tests and mix designs.

C. Materials and installed work may require testing and retesting, as directed by Designer, at anytime during progress of work. Allow free access to material stockpiles and facilities. All tests, including retesting of rejected materials and installed work, shall be done at Contractor's expense.

D. Workmanship: The Contractor is responsible for correction of concrete work which does not conform to the specified requirements, including strength, tolerances and finishes. Correct deficient concrete as directed by the Designer.

1.5 SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR - SUBMITTALS.

B. Product Data: Submit manufacturer's product data with application and installation instructions for proprietary materials and items, including reinforcement and forming accessories, admixtures, patching compounds, waterstops, joint systems, curing compounds, dry-shake finish materials, and others as requested by Designer.

C. Shop Drawings: Submit shop drawings and schedules of all work under this Section for approval prior to fabrication of any material. Shop drawings shall include sufficient plans, sections and detail drawings to suitable scale to permit the erection of the reinforcing steel. Reinforcement: Submit shop drawings for fabrication, bending, and placement of concrete reinforcement. Comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures". Shop Drawings shall include but not be limited to the following:

1. Bar reinforcement shop drawings shall include setting plans, elevations, bending diagrams, cutting lists and other information so as to completely define and establish the location, spacing, size, length, bending, shape, splicing and keying at construction joints and all other pertinent information as required. Drawings shall show grades of reinforcing steel. Opposite hand reinforcing shall be detailed separately. Wall reinforcing shall be detailed on wall elevations and sections.

2. Type, size and location of all accessories required for proper assembling, placing and support of the reinforcement.

3. All openings, depressions, construction and control joints, trenches, sleeves, inserts and all other project requirements affecting reinforcing details and placing.

4. Sizes, thickness of material, methods of assembly, anchorage, galvanizing, shop paint and all other information necessary.

5. Type, size and method of attachment of steel and fiberglass corner protection for encased steel columns.

D. Samples: Submit samples of materials as specified and as otherwise requested by Designer, including names, sources and descriptions.

E. Laboratory Test Reports: Submit laboratory test reports for concrete, concrete materials, and mix design tests.

F. Material Certificates: Provide materials certificates in lieu of materials laboratory test reports when permitted by Designer. Material certificates shall be signed by manufacturer and Contractor, certifying that each material item complies with, or exceeds, specified requirements.

G. Submit written reports to Designer of each proposed mix for each class of concrete to be incorporated into the work at least 15 days prior to start of work. Do not begin concrete production until mixes have been reviewed and accepted by Designer in writing.

H. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant; at no additional cost to the Department and as accepted by Designer. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Designer in writing before using in work. Admixtures shall be from one source only.

I. Batch Ticket Information: Provide concrete delivery tickets showing job name and location, date and time of delivery, quantity of concrete, quality and type of concrete, admixtures, amount of water added, and all other relevant information as described in ASTM C-94. Submit at the end of each week.

J. Submit an as-built survey prepared by a Land Surveyor Licensed in the State of Connecticut showing horizontal and vertical locations of all anchorage devices used for building columns, including columns in pits, and a certification that all anchorage devices have been constructed in the correct locations. Fabrication of column base plates and mobilization of steel erection equipment shall not commence until the as-built survey and certification has been submitted and approved by the Designer.

1.6 PROJECT CONDITIONS

A. Weather: Protect concrete from damage and reduced strength or performance due to weather extremes during mixing, placing and curing.

B. Cold Weather: Unless specifically authorized by the Designer, concrete work shall not proceed when ambient temperature is below 40°F.

1. Comply with ACI 306 in cold weather.

2. Maintain concrete temperature of at least 60°F. Reinforcement, forms and ground in contact with concrete shall be free of frost.

3. Keep concrete and formwork at least 50°F for at least 96 hours after placing concrete.

4. The use of calcium chloride in any form is not permitted. Non-chloride accelerator shall be used when ambient temperature is below 50°F.

5. Admixture manufacturer shall provide technical assistance at no additional cost. A manufacturers representative shall be available for consultation by phone or on site upon 72 hour notice.

C. Hot Weather: Concrete, when deposited, shall be less than 85°F. Cool the mix in a manner acceptable to the Designer if the concrete temperature is higher.

1. Comply with ACI 305 in hot weather.

2. Evaporation Retardant shall be used when ambient temperature exceeds 80°F.

1.7 PRE-INSTALLATIOIN MEETING

A. Conduct a Pre-Installation Meeting at the Project Site in compliance with the requirements of Form 816 Subarticle 1.20-1.05.24-2.

B. Prior to submittal of the specified concrete design mixes, the Contractor shall schedule a meeting to review procedures for producing proper concrete construction.

C. The Contractor shall require attendance by responsible representatives of every party who is involved with the concrete work including, but not limited to, the following:

1. Contractor's superintendent.

2. Testing Agency responsible for the concrete mix design.

3. Testing Agency responsible for field quality control.

4. Concrete Sub-contractor.

5. Ready-mix concrete producer(s).

6. Admixture manufacturer.

7. Concrete pumping Contractor.

8. Formwork Contractor.

9. Concrete Finisher.

D. The Designer will be present at the meeting and must be notified at least 10 days prior to the scheduled date of the meeting.

E. Minutes of the meeting shall be recorded, published and distributed by the Contractor to all parties concerned within 5 working days of the meeting.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

A. Forms for Exposed Finish and Architectural Concrete: Unless otherwise indicated, construct formwork for exposed concrete surfaces with plywood, metal, metal-framed plywood faced or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on plans.

1. Use overlaid plywood complying with U.S. Product PS-1 "A-C or B-B High Density Overlaid Concrete Form", Class I.

2. Use plywood complying with U.S. Product Standard PS-1 "B-B (Concrete Form) Plywood", Class I, Exterior Grade or better, mill-oiled and edge-sealed, with each piece bearing legible inspection trademark.

3. Multipour HDO Plywood, Simpson Timber Company or approved equal.

4. Construct formwork for Architectural concrete using high density overlay products listed above. Joints in formwork shall align with joints indicated on plans. Use appropriate length and width of HDO plywood so that joints in plywood formwork occur at locations shown on Drawings.

B. Forms for Unexposed Finish Concrete: Plywood, lumber, metal, or other acceptable material. Provide lumber dressed on at least 2 edges and one side for tight fit.

C. Form Coatings: Provide commercial formulation form-coating compounds that will not bond with, stain, nor adversely effect concrete surfaces, and will not impair subsequent treatments of concrete surfaces. Provide Nox-Crete Form Coating 250 as manufactured by Nox-Crete, Inc., Duogard II as manufactured by W.R. Meadows or Clean Strip Ultra (J-3 VOC) as manufactured by Dayton Superior or approved equal.

D. Form Ties: For concrete structures which will not be in view or buried below finish grade, use carbon steel factory-fabricated, removable or stay in place snap off type form ties, designed to prevent form deflection and to prevent spalling concrete upon removal. Provide units which will leave no metal closer than 1-1/2" to surface. Provide ties which, when removed, will leave holes not larger than 1" diameter in concrete surface. Patch all holes with non-shrink grout.

1. Form ties and spreaders for walls in areas exposed to view shall be B1 Heavy Duty Stainless Steel Two Strut Coil Tie or B3 Screw on Coil Tie with B30 Screw on Plastic Cones for 1/2 inch bolt diameter, 1-1/2” setback and 1-1/4” diameter to 1” diameter taper by Dayton Richmond or approved equal. Plastic cone holes shall be filled with non-shrink grout. Strut coil ties shall be sized to satisfy loading requirements.

2. In lieu of carbon steel formties specified in Paragraph D. above, fiberglass formties as manufactured by RJD Industries, Dayton Richmond or approved equal may be used. Fiberglass formties shall be standard gray color. The concrete structure shall be finished by grinding the fiberglass formtie flush with the finish surface of the concrete structure.

a. If tapered architectural holes are required, dummy tapered cones having a 1” setback and a taper from 1” to 1-1/4 shall be fastened to the interior of the formwork to achieve the specified pattern on the finish structure.

E. Chamfer Strips: Where chamfers are indicated, provide rubber or polyvinyl chloride type, or smooth clear, sealed softwood.

2.2 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A 615 or A 706, Grade 60, deformed.

B. Epoxy-Coated Reinforcing Bars: ASTM A 775.

C. Steel Wire: ASTM A 82, plain, cold-drawn steel.

D. Epoxy-Coated Wire and Welded Wire Fabric: ASTM A 885.

E. Welded Deformed Steel Wire Fabric: ASTM A 497.

F. Supports for Reinforcement: Provide supports for reinforcement including bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Use wire bar type supports complying with CRSI specifications. Wire for tying shall be 18 gauge black annealed wire conforming to ASTM A 82.

1. For structural slabs, use supports with sand plates or horizontal runners where base material will not support chair legs.

2. For exposed to view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs which are plastic protected (CRSI, Class 1) or stainless steel protected (CRSI, Class 2).

G. Fabrication: Reinforcement shall be accurately formed to dimensions of the plans, details and schedules. Fabrication shall not commence until details and schedules have been approved by the Designer in writing.

1. Reinforcement shall be bent cold, around a pin with a free revolving collar having a diameter ratio to the diameter of the bar not less than:

- Two times for stirrups
- Six times for bars up to and including 1 inch
- Eight times for bars over 1 inch

2. Reinforcement shall not be straightened or re-bent in a manner that will injure the material. Bars with kinks or bends not shown on the plans will not be used.

H. Tapered Plate Basket Assembly:

1. Acceptable product: PNA PD^3 Basket® Assembly or approved equal.

2. Material:
   a. Tapered plate dowels: Plasma cut from hot rolled steel bar meeting ASTM A 36 to within 3/16" of 12" with a 4˚ taper from the widest end to the narrow end.

b. Side frame supports: ¼ inch diameter cold drawn wire meeting ASTM A 108, Grade 1010-1020.
c. De-bonding agent: Tectyl® 506 or approved equal.

3. Fabrication:
a. Weld plate dowels (on widest end only) into side frames, with welded ends alternating along length of assembly.
b. Weld eight gauge wires across side frames at 3 feet o. c. to keep assembly stable during shipping and installation.
c. Thinly and evenly coat plate dowels with de-bonding agent without excessive drips or thickness.
d. Finished assembly shall hold tapered plate dowels to within +/- 1/8 inch of ½ slab depth.
e. Bar dimensions: ½ inch by 12 inch; 2 ½ inch at the midpoint spaced at 27 inches on center.

I. Diamond Shaped Load Plate For Construction Joints:

1. Acceptable product: PNA Diamond Dowel® System or approved equal.

2. Material:
a. Diamond shaped load plate: 3/8" saw cut from hot rolled steel plate meeting ASTM A 36.
b. Pocket former: High density plastic with internal collapsible fins and spacer that hold diamond shaped load plate in correct position and creates a void to its vertical faces.
c. Dimensions of plate: 3/8" by 4-1/2" by 4-1/2".

J. Synthetic Structural Fiber Reinforcement: Provide synthetic structural fibers complying with the following requirements:

1. Synthetic structural fibers shall meet the requirements of ASTM C 1116, Paragraph 4.1.3, Type III.
2. Synthetic structural fibers shall be made of polypropylene and polyethylene.
3. Synthetic structural fibers shall have a minimum length of 1.5” (38 mm).
4. Synthetic structural fibers shall have an aspect ratio (length divided by the equivalent diameter of the fiber) between 80 and 100.
5. Synthetic structural fibers shall be:
a. Grace STRUX 90/40 synthetic fiber reinforcement: or Engineer approved substitute from Fibermesh, Inc. or Euclid Chemical Co.
1) Monofilament Fiber.
2) Specific Gravity: 0.92.
3) Fiber Length: 1.57 inches
4) Aspect Ratio: 90.

6. The minimum addition rate of the synthetic fiber reinforcement shall be:

a. Grace STRUX® 90/40 at [4] pounds per cubic yard.

2.3 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type I or II. Use one brand of cement throughout project, unless otherwise approved in writing by the Designer. The characteristics of the cement and both the fine and coarse aggregate used in the production of all exposed concrete shall be such as to

produce concrete of a light color. These materials are subject to the approval of the Designer based on the inspection of sample panels prepared in accordance with Paragraph 1.05 I.

B. Granulated Blast-furnace Slag:

1. Blast furnace slag shall comply with ASTM C 989, Grade 120. Blast furnace slag shall be mixed with Portland cement for the 5000 psi mixture as indicated on plans at minimum 25% - 50% ratio.

C. Normal Weight Aggregates: ASTM C 33, and as herein specified. Use 3/4" maximum size for all concrete, except high early and lean concrete which requires 3/8" aggregate. Provide aggregates from a single source for exposed concrete.

1. Light Weight Course Aggregate: Expanded shale, clay or slate conforming to ASTM C330. Maximum size of aggregates shall be 3/8".

D. Water: Clean, potable and free from foreign materials in amounts harmful to concrete and embedded steel.

E. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.

1. Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following or approved equal:

a. "Darex AEA" or "Daravair"; Grace Construction Products
b. "Air-Mix"; Euclid Chemical Co.
c. "Sika Aer"; Sika Corp.
d. "MB-VR or MB-AE"; Master Builders.

F. Water Reducing Admixture: ASTM C 494, Type A, and containing not more than 0.1% chloride ions.

1. Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following or approved equal:

a. "Daratard-17"; Grace Construction Products.
b. "Eucon WR-75"; Euclid Chemical Co.
c. "Pozzolith 100XR", Master Builders.
d. "Plastiment", Sika Chemical Corp.

G. High-Range Water Reducing Admixture (Super Plasticizer): ASTM C 494, Type F or Type G and containing not more than 0.05% chloride ions.

1. Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following or approved equal:

a. "ADVA" or "Daracem"; Grace Construction Products.
b. "PSP"; Protex Industries Inc.
c. "Super P"; Anit-Hydro.
d. "Sikament"; Sika Chemical Corp.
e. "Rheobuild"; Master Builders.

H. Water Reducing, Non-Chloride Accelerator Admixture: ASTM C 494, Type E or C, and containing not more than 0.1% chloride ions.

1. Products: Subject to compliance with requirements, provide one of the following:

a. "Accelguard 80"; Euclid Chemical Co.
b. "Pozzutec 20"; Master Builders, Inc.
c. “PolarSet”; Grace Construction Products.
d. Or approved equal.

I. Corrosion Inhibitor: At exterior slabs areas, drives and slabs in contact with soil. ASTM C494 Type C Calcium Nitrite, maximum water cement ratio of 0.40. Minimum dosage rate of three and one half (3.5) gallons per cubic yard. Manufacturer of materials shall have a minimum of five years experience in the production of corrosion inhibitors for concrete.

1. Test and Performance Data: The corrosion inhibitor shall have been tested in accordance with the following test procedures:

a. FHWA/RD-83/012.
b. ASTM G61
c. ASTM G109

J. Water Reducing, Retarding Admixture: ASTM C 494 Type D, and containing not more than 0.1% chloride ions.

1. Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following or approved equal:

a. "Edoco 20006"; Edoco Technical Products.
b. "Pozzolith Retarder"; Master Builders.
c. "Eucon Retarder 75"; Euclid Chemical Co.
d. "Daratard"; W. R. Grace.
e. "Plastiment"; Sika Chemical Co.

K. Shrinkage Control Admixture shall be “Eclipse Plus” by Grace Construction Products or approved equivalent product.

L. Prohibited Admixtures: Calcium chloride shall not be used.

M. High Early Strength Cement: High early strength cement shall be required at manholes locations for riser sections and elsewhere as indicated on plans. High early strength material shall be a hydraulic cement, Five Star Highway Patch as manufactured by Five Star Products, Inc., Emaco T415 as manufactured by Master Builders Inc., HD50 as manufactured by Dayton Superior or approved equal meeting or exceeding the following physical properties:

Property	Test	Result
1. Compressive Strength	ASTM C-109	2 hours - 2,000 psi 1 day - 5,000 psi

			7 day - 7,000 psi
2.	Bond Strength	ASTM C-882	1 day - 1,500 psi 7 day - 2,000 psi
3.	Length Change	ASTM C-157	28 day wet + 0.05% 28 day dry - 0.05%
4.	Set Time	ASTM C-266	Initial - 15 min. Final - 30 min.
5.	Freeze /Thaw Resistance Relative Durability Factor	ASTM C-666 (A)	90%

2.4 RELATED MATERIALS

A. Reglets: Where resilient or elastomeric sheet flashing or bituminous membranes are terminated in reglets, provide reglets of not less than 26 gauge galvanized sheet steel. Fill reglet or cover face opening to prevent intrusion of concrete or debris.

B. Expanding Waterstop Strip: Expanding waterstop shall be natural rubber product that has been chemically modified to incorporate hydrophilic agents. This process shall permit the waterstop materials to undergo controlled expansion in the presence of moisture. The expansion shall provide a double locking water-stop, one from the rubber's natural resiliency and one from expansion. Expansion shall occur in three dimensions: width, height, and length and will follow the direction of least resistance. The waterstop shall incorporate a stainless steel wire net within the material. The wire net shall eliminate unnecessary expansion in length and width and help prevent "winding" action when fastened to concrete. The water stop materials shall have excellent durability and resistance to chemicals and shall be capable of performing in salt water and cement water. The materials shall not contain any toxic substance or heavy metals and shall be environmentally safe. Physical properties shall include the following:

Physical Properties	Test Method	Value
Size		.78 in X .39 in (0.78" x 0.39")
Hardness	ASTM D2240	30±6
Tensile Strength	ASTM D412	100 psi
% Elongation at Ultimate Failure	ASTM D412	500%
Volume Exp. Coefficient		2
Vulcanization		No
Days to Max Vol Expansion		35
Specific Gravity	ASTM D792	1.18

1. Expanding Sealant: Provide a single component hydrophilic sealant to be used in conjunction with expanding waterstop for all new and repair applications where rough surfaces are encountered. Physical properties shall be as follows:

Physical Properties	Test Method	Value
Hardness	ASTM D2240	28
Tensile Strength	ASTM D412	350 psi
% Elongation at Ultimate Failure	ASTM D412	700%
Volume Exp. Coefficient		1.8
Polymerized		Yes
Tack Free		10 hours

C. Non-Shrink Grout: Non-shrink, Non-metallic Grout: Provide non-metallic cement based grout requiring only addition of water, with minimum 28-day compressive strength of 8,000 psi, with shrinkage compensation characteristics in both the plastic and hardened states, conforming with ASTM C1107, "Grade C". Manufactured by: Five Star Grout 100 by Five Star Products Inc., SikaGrout 212 as manufactured by Sika Corporation, or Masterflow 928 by Master Builders, Inc. or approved equal.

D. Moisture-Retaining Cover: Provide HydraCure reusable, reflective wet cure blankets as manufactured by PNA Construction Technologies, Transguard 4000 Reusable Wet Cure Covers by Reef Industries, Inc. or approved equal. Wet cure blankets shall be comprised of a non-woven polypropylene fabric coated with a white-pigmented polyethylene, total thickness 42 mils.

E. Liquid Membrane-Forming Curing Compound:

1. Curing and Sealing Compound: Clear styrene acrylate or acrylic polymer type, 30% solid content minimum. Compound shall be "Super Rez Seal" or "Super Floor Coat" by The Euclid Chemical Company or "Masterseal 66" by Master Builders or approved equal.

2. Dissipating Resin Curing Compound: Dissipating resin type conforming to ASTM C309, Type I, "Kurez DR" by The Euclid Chemical Company, "Vulkem 2100" by Mameco International, Bro-Cure by Nox-Crete, Inc. or approved equivalent product. The film must chemically break down in a two to four week period.

3. Compounds containing sodium silicate are prohibited.

F. Underlayment Compound: Refer to Section 03 54 00 - TROWELABLE AND SELF-LEVELING CONCRETE UNDERLAYMENT.

G. Bonding Compound: Polyvinyl acetate or acrylic base.

1. Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following or approved equal:

a. Acrylic or Styrene Butadiene:

1) "J-40 Bonding Agent"; Dayton Superior Corp.
2) "Everbond"; L & M Construction Chemicals.
3) "Hornweld"; A. C. Horn, Inc.

4) "Daraweld C"; W. R. Grace.

H. Evaporation Retarder shall be "Eucobar" by The Euclid Chemical Company or "Confilm" by Master Builders or approved equivalent product.

I. Compressible Filler Materials:

1. Compressible foam expansion joint filler material used at Joints between abutting concrete surfaces indicated to receive surface sealant materials shall be a flexible synthetic gray foam of isomeric polymers in a mini, closed cell structure. The foam shall be lightweight, flexible, highly resilient with a recovery of over 99%. The cell structure shall be virtually non-absorbent. The foam shall be non-extruding, non-gassing, non-staining and shall be capable of bonding to concrete surfaces with common cartridge adhesives. Provide Ceramar as manufactured by W. R. Meadows or approved equal.

J. Curing/Sealer/Hardening/Dustproofing Sealer:

1. Where concrete curing agent/sealer/hardener/dustproofing is called for on the plans or is specified herein for structural slabs, provide “Ashford Formula” manufactured by Curecrete Chemical Company, or approved equal from Tnemec, Chemprobe or Unitex with the following attributes:

a. A non-film forming chemical that penetrates into the concrete where it reacts with the alkali and lime, commonly called concrete salts. During this reaction it chemically combines with the salts melting them within the concrete into a gel which locks the pores of the concrete.

b. This process densifies the concrete into a solid mass that does not allow penetration into the concrete surface.

c. The performance criteria shall be established by tests conducted by recognized independent testing laboratories.

1) Curing: Reduce moisture loss by a minimum of 90% during initial 24 hours.

2) Abrasion: Taber C-17 wheel, min. 30% increase in abrasion resistance.

3) Bonding: ASTM-D3359, min. 17% increase in epoxy adhesion.

4) Hardening: ASTM-C-42, min. 38% increase in compressive strength at 28 days.

5) ASTM-C-805, min. 13% increase impact resistance, Schmidt Hammer Test Method.

6) Permeability: ASTM modified, 7 in. head, min. leakage 0.0005 cubic inches/hour.

7) Chemical Resistance: The manufacturer shall provide a chemical resistance guide listing test results by independent laboratories.

2.5 PROPORTIONING AND DESIGN OF MIXES

A. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. If trial batch method used, use an independent

testing facility acceptable to Department for preparing and reporting proposed mix designs. The testing facility shall not be the same as used for field quality control testing.

B. Submit written reports to Designer for review of design mix for specified strength of concrete within 15 days prior to start of work. Do not begin concrete production until mixes have been reviewed by Designer.

C. Recommended mix designs and concrete admixtures:

Location	f'_c	w/c Ratio	Air Entr	DCI	HRWRA	Eclipse+	Blast Furnace Slag	Sealer	Reinf. E.C.	Macro Fibers
Foundation Beams and Pile Caps	4000 psi	0.4	4% ± 1.5%	No	Yes	No	No	No	No	No
Structural Slabs and walls in Pits	5000 psi	0.4	4% ± 1.5%	3.5 gal/CY	Yes	Yes	100 lb/CY	Yes	Yes	4 lbs. CY Strux 90/40
Structural Slabs on Ground	4000 psi	0.4	4% ± 1.5%	3.5 gal/CY	Yes	Yes	100 lb/CY	Yes	Yes	4 lbs. CY Strux 90/40
Foundation. Mats and Light Weight Conc. Infill	4000 psi	0.5	4% ± 1.5%	No	No	No	No	No	No	No
Curbs, Toppings & Steel Column Encasement	4000 psi	0.4	6% ± 1.5%	No	No	yes	No	Yes	Yes	4 lbs. CY Strux 90/40
Mudmat	3000 psi	0.45	6% ± 1.5%	no	no	no	no	no	no	no

D. Mix Proportions for High Early Concrete: High early concrete shall be a preblended, prepackaged material requiring only the addition of water and stone aggregate.

E. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant; at Contractor's expense and as accepted by Designer. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Designer before using in work.

F. Admixtures

1. Use water-reducing admixture or high range water reducing admixture (super plasticizer) in all concrete in strict accordance with the manufacturer's printed instructions.

2. Use non-chloride accelerating admixture in concrete slabs placed at ambient temperatures below 50° F in strict accordance with the manufacturer's printed instructions.

3. Use high-range water-reducing admixture in pumped concrete, concrete required to be watertight, and concrete with water/cement ratios below 0.50.

4. Use air-entraining admixture in all concrete, unless otherwise indicated. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having total air content of 6.5% with a tolerance of ± 1-1/2%.

G. Consistency:

1. The consistency shall be uniformly maintained within the allowable range of slump for the job materials. The specified water cement ratio shall be maintained at all times.

2.6 CONCRETE MIXING

A. Ready-Mix Concrete: Comply with requirements of ASTM C 94, and as herein specified. Delete references for allowing additional water to be added to batch for material with insufficient slump. Addition of water to the batch will not be permitted.

1. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C 94 may be required. When air temperature is between 85°F (30° C) and 90°F (32°C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes, and when air temperature is above 90°F (32°C), reduce mixing and delivery time to 60 minutes.

2. During cold weather, concrete shall not be mixed while the temperature is below 40 degrees without the permission of the Engineer. If permission is granted for mixing under such conditions, aggregates or water, or both, shall be heated and the concrete shall be placed at a temperature not less than 50 degrees nor more than 80 degrees F.

B. High Early Strength Concrete: Follow manufacture's product specific installation guidelines. Cement shall be added to a premeasured amount of water that does not exceed the manufacturer's maximum recommended water content. Material can be extended up to 60% using pea gravel.

C. Retempering of concrete by adding water or any other material shall not be permitted.

PART 3 - EXECUTION

3.1 GENERAL

A. Coordinate the installation of joint materials and vapor retarders with placement of forms and reinforcing steel.

3.2 FORMS

A. Design, erect, support, brace, and maintain framework to support vertical and lateral, static, and dynamic loads that might be applied until such loads can be supported by concrete structure. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation, position and dimensions of the concrete called for on the plans. Maintain formwork construction tolerances complying with ACI 347.

B. Design formwork to be readily removable without impact, shock, or damage to cast-in-place concrete surfaces and adjacent materials.

C. Construct forms to sizes, shapes, lines, and dimensions shown, and to obtain accurate alignment, location, grades, level and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required in work. Use selected materials to obtain required finishes. Solidly butt joints and provide back-up at joints to prevent leakage of cement paste.

D. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and for easy removal.

E. Provide temporary openings where interior area of formwork is inaccessible for clean out, for inspection before concrete placement, and for placement of concrete. Securely brace temporary openings and set tightly to forms to prevent loss of concrete mortar. Locate temporary openings on forms at inconspicuous locations.

F. Chamfer exposed corners and edges as indicated, using wood, metal, PVC, or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.

G. Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses, and chases from trades providing such items. Accurately place and securely support items built into forms.

H. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt or other debris just before concrete is placed. Retightening forms and bracing after concrete placement is required to eliminate mortar leaks and maintain proper alignment.

I. Form ties and spreaders shall be of such type as to leave no metal closer than 1 inch from the exposed concrete surfaces. Tie rod holes shall be plugged solid with mortar of same color and texture as the concrete. Cutting ties back from the surface will not be permitted.

J. Shoring posts or uprights shall not be removed until the supported member has acquired sufficient strength to safely support its own weight and all loads upon it. Members subjected to additional loads during construction shall be adequately shored and braced. The Contractor shall assume full responsibility for any damage to the structure due to premature removal of forms.

K. Openings, Sleeves, Pipes and Embedded Items:

1. Conform to requirements of the “ACI Building Code” Section 503, pipes, conduits, etc., embedded in concrete. The Contractor shall obtain the necessary information as to the exact locations of holes, sleeves, recesses, etc. and cooperate with the interested trades so that these items will be installed in the work. Failure of the contractor to obtain the information and to cooperate shall require him to do all cutting and patching of concrete that may thereby become necessary. Provide shelves for slabs and pockets for floor beams in concrete foundation work as shown or required by structural plans.

L. Conduits and Sleeves: The following applies to conduits, pipes, and sleeves which may be embedded in concrete. Sizes refer to outside diameter.

1. Pipes shall not be coated with paint or enamel or otherwise except galvanizing, sherardizing or their approved equivalent.

2. Reinforcing shall not be cut or displaced from its indicated position to accommodate pipes; in particular pipes shall not be placed between forms and bottom slab rods, or above top slab rods.

3. In slab pipes shall not be larger than 1/4 the slab or wall thickness and shall be placed and kept within the middle two quarters of that thickness.

4. Pipes larger than 1/6 the slab or wall thickness shall be run roughly parallel and at right angles to the reinforcing, not diagonally.

5. Pipes nearly parallel shall be spaced at least three diameters on centers.

6. Pipes shall not be embedded lengthwise in beams or columns.

M. Openings Through Beams: Openings through beams from side to side may be formed within the middle third of the span. Openings not higher than 1/4 of the depth of the beam or longer than 1/2 the depth may be formed in any manner provided it is below the slab, clears bottom reinforcing by at least 2-1/2 in. and multiple openings are spaced at least thrice their length on centers.

N. Under Slab Conduit and Utility Supports: Under slab conduit and utility supports shall be configured and spaced as per details in the Structural Drawings.

3.3 PLACING REINFORCEMENT

A. Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars", for details and methods of reinforcement placement and supports, and as herein specified.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials which reduce or destroy bond with concrete.

C. Accurately position, support, and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, or hangers, as required.

D. Place reinforcement to obtain at least minimum coverage for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire fabric in as long lengths as practicable. Lap adjoining pieces at least one full mesh (12 in. minimum) and lace splices with wire. Offset end laps in adjacent widths to prevent continuous laps in either direction.

F. Material shall bear mill identification symbol, and be stored so that different types may be identified.

3.4 JOINTS

A. Construction Joints: Locate and install construction joints as indicated, or, if not indicated, locate so as not to impair strength and appearance of the structure, as acceptable to Designer. Submit proposed construction joint locations to the Designer for approval. Provide construction joints using diamond dowel system wherever concrete placement is interrupted for more than 1/2 hour and at the end of placement. Coordinate with expansion joint locations where possible. Provide diamond dowel system at not more than 18 in. on center to transfer vertical loads but permit horizontal movement.

B. Control Joints: [Also called "Contraction Joints"]. Provide control joints at least one-fourth the slab depth by saw-cutting, tooling, or using removable inserts. Provide plate dowel basket assembly at joint locations per manufacturer's recommendations prior to concrete placement. Provide control joints at locations indicated or approved by Designer.

C. Unless otherwise indicted on plans provide keyways at least 1-1/2" deep in construction joints in walls, slabs, and between walls and footings; accepted bulkheads designed for this purpose may be used for slabs.

D. Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints, except as otherwise indicated.

E. When the placing of concrete is suspended, necessary provisions shall be made for joining future work before the placed concrete takes its initial set. For the proper bonding of old and new concrete, such provisions shall be made for grooves, steps, keys, dovetails, reinforcing bars or other devises as may be described. Before depositing new concrete against old concrete which has hardened, the surface of the hardened concrete shall be cleaned by heavy steel broom, roughened slightly, wetted, and covered with a neat coating of cement paste or grout. Install joint sealant where shown on plans in accordance with manufacturers instructions.

F. Expansion Joints: If indicated, shall be built in the location and to the dimensions and details shown on the plans.

3.5 INSTALLATION OF EMBEDDED ITEMS

A. Set and build into work anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions, and directions provided by suppliers of items to be attached thereto.

B. Installation of Expanding Waterstop Strip:

1. Install as indicated on the plans. Waterstop must be completely encapsulated in concrete per manufacturer's recommendations. The minimum cover is 2 inches.

2. Apply waterstops to smooth concrete surfaces using concrete screws placed 8 to 10 inches apart which penetrate concrete a minimum of 3/4 inch. Apply tension to the strip while screwing to obtain close adhesion to concrete. Overlap ends a minimum of 2 inches when joining. Cut the strip to fit corners closely and apply expanding sealant over joints.

3. For rough surfaces screw waterstop in place as specified above and apply a continuous 1/2” bead of manufacturer's single component hydrophilic sealant along both sides of the waterstop.

3.6 PREPARATION OF FORM SURFACES

A. Clean re-used forms of concrete matrix residue, repair and patch as required to return forms to acceptable surface condition.

B. Coat contact surfaces of forms with a form-coating compound before reinforcement is placed.

C. Thin form-coating compounds only with thinning agent of type, amount, and under conditions of form-coating compound manufacturer's directions. Do not allow excess form-coating material to accumulate in forms or to come into contact with in-place concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions.

D. Coat steel forms with a non-staining, rust-preventative form oil or otherwise protect against rusting. Rust-stained steel formwork is not acceptable.

3.7 CONCRETE PLACEMENT

A. Preplacement Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast-in. Notify other crafts to permit installation of their work; cooperate with other trades in setting such work. Moisten wood forms immediately before placing concrete where form coatings are not used.

1. Apply temporary protective covering to lower 2' of finished walls adjacent to poured floor slabs and similar conditions, and guard against spattering during placement.

B. Coordinate the installation of joint materials and moisture barriers with placement of forms and reinforcing steel.

C. General: Comply with ACI 304 "Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete", and as herein specified.

1. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete as nearly as practicable to its final location to avoid segregation.

D. Placing Concrete in Forms: Deposit concrete in forms in horizontal layers not deeper than 24" and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.

E. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures for consolidation of concrete in accordance with ACI 309.

F. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine. Place vibrators to rapidly penetrate placed layer and at least 6" into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion limit duration of vibration to

time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.

G. Placing Concrete Slabs: Verify that waterproofing is in place at slab-on-grade locations and all joints sealed, all reinforcing steel placed and supported and all mechanical and electrical pipes and conduits placed. Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed.

H. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.

I. Bring slab surfaces to correct level with straightedge and strike-off. Use bull floats or darbies to smooth surface, free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.

1. Placement of concrete in floor slabs shall be brought to the prescribed level by the use of steel T, or pipe screeds, set to produce the required thickness of the slab above the form. The process known as "wet screeding" by use of darby without set guides will not be allowed. Use of vibrating screeding apparatus may be allowed, but not to avoid compaction by the means specified. Methods using laser light may be approved if proper procedures for establishing the thickness of the slab and the surface elevations are approved by the Designer. Tolerances in level shall not exceed those given in ACI 302.1R-89, ACI 117, and ASTM E1155 as follows:

   a. All Elevated Slabs and Slabs Supported by Structural Steel: Floors shall conform to a Floor Flatness Number of not less than F(F) 30; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 15.

   b.. All Slabs at Grade: Floor shall conform to a Floor Flatness Number of not less than F(F) 25 and a Floor Levelness Number of not less than F(L) 20; with minimum local values of flatness, F(F) 17; and of levelness, F(L) 15.

2. Testing of F(F) and F(L) tolerances shall be conducted in accordance with the provisions set forth in ASTM E1155 and ASTM Committee E.6.21.1 using a measuring device specifically designed to measure floor flatness.

3. All floor tolerance measurements shall be made within 24 hours after slab installation. Results of all tests including formal notice of acceptance or rejection of the work shall be provided to the Contractor within 72 hours after slab installation.

J. Maintain reinforcing in proper position during concrete placement operations.

K. Cold Weather Placing: Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 306 and as herein specified. Uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50°F and not more than 80°F at point of placement.

1. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

2. Do not use calcium chloride, salt, and other materials containing antifreeze agents or chemical accelerators, unless otherwise accepted in mix designs.

L. Hot Weather Placing: When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified.

1. Cool ingredients before mixing to maintain concrete temperature at time of placement below 85°F. Mixing water may be chilled, or chopped ice may be used to control temperature provided water equivalent of ice is calculated to total amount of mixing water.

2. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedment in concrete. Fog spray forms, reinforcing steel, and subgrade just before concrete is placed.

3. Use water-reducing retarding admixture (Type D) when required by high temperatures, low humidity, or other adverse placing conditions.

4. Do not use retarding admixtures unless accepted in mix designs, or approved by Designer.

5. When high temperatures, low humidity and dry winds create conditions which may produce plastic cracking (when the rate of evaporation exceeds 2 lbs. per s.f. per hr.), the evaporation retarder specified may be required to be applied by spray one or more times during the finishing operation. Placing under these conditions should be reviewed by the Designer/Testing Laboratory prior to placing any concrete.

M. The Contractor shall be held responsible for any defective work, resulting from freezing or injury in any manner during placing and curing, and shall replace such work at no additional expense to the Department.

3.8 FINISH OF FORMED SURFACES

A. Rough Form Finish: This finish shall be used for formed concrete surfaces not exposed-to-view in the finish work or by other construction, unless otherwise indicated. The concrete surface may have texture imparted by form facing material used. Tie holes and defective areas shall be repaired and patched and fins and other projections exceeding 1/4" in height shall be rubbed down or chipped off.

B. Smooth Form Finish: This finish shall be used for formed concrete surfaces exposed-to-view, or that are to be covered with a coating or covering material applied directly to concrete such as waterproofing, dampproofing, painting, or other similar system. This as-cast concrete surface shall be obtained with selected form facing material, arranged orderly and symmetrically with a minimum of seams. Repair and patch defective areas with fins or other projections completely removed and smoothed.

C. Architectural Concrete: This finish shall be used for formed concrete surfaces at exterior slab and stair locations. These surfaces shall have all bug hole greater than 1/4" filled followed by medium sandblast. Formwork and control joints locations shall be indicated on Plans. Tops of walls shall have cast chamfered edges, no tooled edges will be permitted.

D. Related Unformed Surfaces: This finish shall be used at tops of walls, horizontal offsets and similar unformed surfaces occurring adjacent to formed surfaces. Strike-off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.9 MONOLITHIC SLAB FINISHES

A. Trowel Finish: Apply trowel finish to monolithic concrete surfaces to be exposed-to-view.

B. Non-Slip Broom Finish: For sidewalk surfaces including steps, and ramps, and elsewhere as indicated apply non-slip broom finish and water repellent penetrating sealer specified in Section 07 19 00.

1. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber bristle broom perpendicular to main traffic route. Coordinate required final finish with Designer before application.

C. Tooled Joints: Tool joints in slab surfaces shall be as indicated on Plans.

3.10 CONCRETE CURING AND PROTECTION

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

1. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Keep continuously moist for not less than 7 days.

2. Begin final curing procedures immediately following initial curing and before concrete has dried. Continue final curing for at least 7 days in accordance with ACI 301 procedures. Avoid rapid drying at end of final curing period.

B. Curing Methods: Perform curing of concrete by curing and sealing compound, by moist curing, by moisture-retaining cover curing, and by combinations thereof, as herein specified.

C. Provide Moisture Curing by Following Methods:

1. Keep concrete surface continuously wet by covering with water. (After initial set)

2. Use fog misting when the rate of evaporation exceeds 2 lbs/sq.Ft./Hour. Fogging shall continue after the finishing operation until absorptive cover is placed over the concrete.

3. Cover concrete surface with specified absorptive cover, thoroughly saturating cover with water and keeping continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with 4" lap over adjacent absorptive covers.

D. Provide moisture-cover curing as follows: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 4" and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

E. Curing Formed Surfaces: Cure formed concrete surfaces, including undersides of beams, supported slabs, and other similar surfaces by moist curing with forms in place for full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.

F. Curing Unformed Surfaces: Cure unformed surfaces, such as slabs, floor topping, and other flat surfaces by application of appropriate curing method.

1. Final cure concrete surfaces to receive liquid floor hardener or finish flooring by use of moisture-retaining cover, unless otherwise directed.

3.11 REMOVAL OF FORMS

A. Formwork not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 50°F for 48 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form removal operations, and provided curing and protection operations are maintained.

B. Formwork supporting weight of concrete, such as the underside of beams, slabs, girders, and other similar construction, shall remain in place for a minimum of 14 days or until concrete has attained design minimum 28 day compressive strength, whichever is greater. Determine potential compressive strength of in-place concrete by testing field-cured specimens representative of concrete location or members.

C. Form facing material may be removed 4 days after placement, only if shores and other vertical supports have been arranged to permit removal of form facing material without loosening or disturbing shores and supports.

3.12 RE-USE OF FORMS

A. Clean and repair surfaces of forms to be re-used in work. Split, frayed, delaminated, or otherwise damaged form facing material will not be acceptable for exposed surfaces. Apply new form coating compound as specified for new formwork.

1. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joint to avoid offsets. Do not use "patched" forms for exposed concrete surfaces, except as acceptable to Designer.

2. Forms for architectural concrete shall not be reused if there is any evidence of surface wear and tear or defect which would impair the quality of the surface. Forms shall be thoroughly cleaned and properly coated before reuse.

3. Formwork for architectural concrete shall be observed continuously while concrete is being placed to insure that there are no deviations from desired elevation, alignment, plumbness, or camber. If during construction, any weakness develops and the falsework shows any undue settlement or distortion, the work shall be stopped, the affected construction removed if permanently damaged, and the falsework strengthened.

3.13 CONCRETE SURFACE REPAIRS

A. General: Any defective work disclosed after removal of forms shall be immediately removed and replaced. If in the opinion of the Designer, the surface of the concrete cannot be repaired satisfactorily, the entire section shall be removed and replaced at no additional expense to the Department.

B. Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removal of forms, when acceptable to Designer.

1. Cut out honeycomb, rock pockets, voids over 1" in any dimension, and holes left by tie rods and bolts, down to solid concrete but, in no case to a depth of less than 1". Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water, and brush-coat the area to be patched with specified bonding agent. Place patching mortar after bonding compound has dried.

C. For exposed-to-view surfaces, blend white Portland cement and standard Portland cement so that, when dry, patching mortar will match color surrounding. Provide test areas at inconspicuous location to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.

D. Repair of Formed Surfaces: Remove and replace concrete having defective surfaces if defects cannot be repaired to the satisfaction of the Designer. Surface defects, as such, include color and texture irregularities, bulges, uneven surfaces, air bubbles, honeycomb, rock pockets; fins and other projections on surface; and stains and other discolorations that cannot be removed by cleaning. Flush out form tie holes, fill with dry pack mortar, or precast cement cone plugs secured in place with bonding agent.

E. Repair concealed formed surfaces, where possible, that contain defects that affect the durability of concrete. If defects cannot be repaired, remove and replace concrete.

F. Repair of Unformed Surfaces: Test unformed surfaces, such as monolithic slabs, for smoothness and verify surface plane to tolerances specified for each surface and finish. Correct low and high areas as herein specified. Test unformed surfaces sloped to drain for trueness of slope, in addition to smoothness using a template having required slope.

G. Repair defective areas, except random cracks and single holes not exceeding 1" diameter, by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts and expose reinforcing steel with at least 3/4" clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding compound. Mix patching concrete of same materials to provide concrete of same type or class as original concrete. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

H. Repair isolated random cracks and single holes not over 1" in diameter by dry-pack method. Groove top of cracks and cut-out holes to sound concrete and clean of dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding compound. Mix dry-pack, consisting of one part Portland cement to 2-1/2 parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing. Place dry pack after bonding compound has dried. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched area continuously moist for not less than 72 hours.

I. Perform structural repairs with prior approval of Designer for method and procedure, using specified epoxy adhesive and mortar.

J. Repair methods not specified above may be used, subject to acceptance of Designer.

3.14 ENCASEMENT OF COLUMNS

A. Encasement of steel columns shall conform to the 2005 State Building Code requirements in Table 601 for Type IB construction.

B. Encasement of steel columns shall conform to the 2005 State Building Code requirements in Chapter 7.

C. Steel columns shall be cleaned of loose rust, mill scale and any other material that could affect the integrity of the concrete encasement. The floor slab at the base of the column shall be roughened prior to placement of the welded wire fabric and forms. Welded wire fabric need not be attached to the column, but must be positively offset from the interior surface of the forms to ensure compliance with requirements in the State Building Code.

D. Corner protective elements shall be installed on each corner of each column as indicated in the Plans.

3.15 QUALITY CONTROL TESTING DURING CONSTRUCTION

A. The Contractor shall employ a testing laboratory to perform tests and to submit test reports.

1. Sampling and testing for quality control during placement of concrete may include the following, as directed by the Engineer.

B. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.

1. Slump: ASTM C 143; Upon verification of the initial slump by the Testing Agency, perform one test for each concrete load at point of discharge and one test for each set of comprehensive strength test specimens. Perform additional tests when visual inspection indicates consistency has changed, and as directed by the Engineer.

2. Air Content: ASTM C 173, volumetric method for lightweight or normal weight concrete; ASTM C 231 pressure method for normal weight concrete; one for each day's pour of each type of air-entrained concrete.

a. Concrete Temperature: Test hourly when air temperature is 40°F and below, and when 80°F and above; and each time a set of compression test specimens are required.

b. Compressive Strength Tests: ASTM C 39; one set for each day's pour exceeding 5 cu. yds. plus additional sets for each 50 cu. yds. over and above the first 25 cu. yds. of each concrete class placed in any one day; one specimen tested at 7 days, two specimens tested at 28 days, and one specimen retained in reserve for later testing if required.

c. When frequency of testing will provide less than 5 strength tests for a given class of concrete, conduct testing from at least 5 randomly selected batches or from each batch if fewer than 5 are used.

d. When total quantity of a given class of concrete is less than 50 cu. yds., strength test may be waived if, in the judgment of the Engineer, adequate evidence of satisfactory strength is provided.

e. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.

f. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength, and no individual strength test result falls below specified compressive strength by more than 500 psi.

C. Test results will be reported in writing to Designer, Engineer, and Contractor within 24 hours after tests. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name and location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials; compressive breaking strength and type of break for both 7-day tests and 28-day tests.

D. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted but shall not be used as the sole basis for acceptance or rejection.

E. Additional Tests: The Contractor's Independent testing service shall make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by Designer. Testing service may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed.

END OF SECTION 03 30 00

SECTION 05 10 00 - STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and fabricate all items necessary to complete work indicated on the plans and as specified herein. Structural steel shall be as defined in the AISC Code of Standard Practice for Steel Building and Bridges. Work shall include, but not be limited to the following:

1. Structural beams and columns at the Independent Wheel True Facility..

B. Include anchor bolts for column bases, column setting, base and bearing plates, beams, columns, column and beam detail connections, angles, bolts, stiffeners, plates and electrodes (for welded work).

C. The following surfaces shall be milled:

1. Contact surfaces between column and base plates.
2. Abutting ends of columns at column connections.
3. Contact surfaces between beam seat and bearing plate.
4. Bearing stiffener

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Carefully examine all of the Contract Documents for requirements which affect the work of this section.

B. Other specifications sections which directly relate to the work of this section include, but are not limited to the following:

1. Section 03 30 00 - Cast-in-place Concrete
2. Section 05 30 00 - Metal Decking
3. Section 05 50 00 - Metal Fabrications
4. Section 07 81 00 - Applied Fireproofing
5. Section 09 91 00 - Painting

1.3 QUALITY ASSURANCE

A. Codes and Standards: Comply with provisions of following, except as otherwise indicated:

1. AISC "Code of Standard Practice for Steel Buildings and Bridges".

a. Paragraph 4.2.1 of the above code is hereby modified by deletion of the following sentence: "This approval constitutes the Department's acceptance of all responsibility for the design adequacy of any connections designed by the fabricator as a part of his preparation of these shop drawings".

2. AISC "Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings", including "Commentary" and Supplements thereto as issued.

3. AISC "Specifications for Structural Joints using ASTM A 325 or A 490 Bolts" approved by the RCRBSJ “Research Council on Riveted and Bolted Structural Joints” of the Engineering Foundation.
4. ANSI/AWS D1.1 "Structural Welding Code".
5. ASTM A 6 "General Requirements for Delivery of Rolled Steel Plates, Shapes, Sheet Piling and Bars for Structural Use".
6. ASTM A709 "Specifications for Carbon and High Strength Low Alloy Structural Steel Shapes, Plates, and Bars and Quenched and Tempered Alloy Structural Steel Plates for Bridges."
7. SSPC "Painting Manual Vol. 1, Good Painting Practice".
8. SSPC "Painting Manual Vol. 2, Systems and Specifications".

B. Qualifications for Welding Work: Qualify welding processes and welding operators in accordance with AWS "Standard Qualification Procedure".

1. Provide certification that welders to be employed in work meet the requirements of Article 6.03.03, section 6, subsection (a) of the Form 816.

2. Provide certification that welders to be employed in work have satisfactorily passed AWS qualification tests within past 12 months.

3. If recertification of welders is required, retesting will be Contractor's responsibility.

C. Fabricators Qualifications: Engage a firm experienced in fabricating structural steel similar to that indicated for the project and with a record of successful in-service performance.

1. Fabricator must participate in the AISC quality certification program and be designated in AISC certified plant as follows:

a. Category STD, conventional steel structures.

b. Fabricator shall be registered with and approved by authorities having jurisdiction.

D. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.

E. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint Endorsement P1 or SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."

1.4 TESTS

A. Inspection and Testing: The Contractor shall employ and pay an independent testing agency to inspect and test steel during fabrication and erection. The Contractor shall cooperate and permit all requested inspection and testing. All reporting by the testing agency shall be provided concurrently to the Department and the Contractor during testing.

B. Field Welds: The Contractor shall employ and pay an independent testing agency to test all welds at moment connections in strict compliance with AISC and Building Code Requirements.

1.5 SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: Submit producer's or manufacturer's specifications and installation instructions for following products. Include laboratory test reports and other data to show compliance with specifications (including specified standards).

1. Structural steel (each type), including certified copies of mill reports covering chemical and physical properties.

2. High-strength bolts (each type), anchor bolts, including nuts and washers.

3. Structural steel primer paint and top coat paint.

4. Shrinkage-resistant grout.

5. Expansion Fastening systems

6. Adhesive Anchor Rod systems

C. Shop Drawings: Submit shop drawings, after field survey and adjustments are made, to the Designer for approval. Including complete details and schedules for fabrication and assembly of structural steel members, procedures and diagrams.

1. Include details of cuts, connections, camber, holes, and other pertinent data.
2. Include embedment drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.
5. Identify members and connections of the seismic-load-resisting system.
6. Indicate locations and dimensions of protected zones.
7. Identify demand critical welds.
8. For structural-steel connections indicated to comply with design loads, include structural design data signed and sealed by the qualified professional engineer responsible for their preparation. Additionally submit supplemental calculations stamped by a Registered Professional Engineer in the State of Connecticut for all braced and moment frame connections and for any non-standard or untypical connections.

D. Test Reports: Submit copies of reports of tests conducted on shop and field bolted and welded connections. Include data on type(s) of tests conducted and test results.

E. Welding Certificates: Provide welding certificates for welders who will be used for field welding.

1.6 DELIVERY, STORAGE AND HANDLING

A. Refer to Form 816 Article 1.06.03 and Form 816 Article 1.20-1.06.03 for additional information.

B. Deliver structural steel to project site at such intervals to insure uninterrupted progress of work.

C. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete, in ample time to not delay work.

D. Store materials to permit easy access for inspection and identification. Keep steel members off ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from erosion and deterioration.

E. Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures. Repair or replace damaged materials or structures as directed.

F. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
   1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
   2. Clean and relubricate bolts and nuts that become dry or rusty before use.
   3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

1.7 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Metal Surfaces, General: For fabrication of work which will be exposed to view, use only materials which are smooth and free of surface blemishes including pitting, seam marks, roller marks, rolled trade names and roughness. Remove such blemishes by grinding, or by welding and grinding, prior to cleaning, treating and application of surface finishes.

B. Structural Steel Shapes, Plates and Bars: Carbon Steel ASTM A 36, except where high-strength is noted, ASTM A 572, Grade 50, and other types as indicated on Plans.

C. All wide flange shapes: ASTM A992, grade 50 ksi

D. Steel Pipe: ASTM A53, grade B, Fy=35 ksi

E. Anchor Bolts: ASTM A 307, nonheaded type unless otherwise indicated.

F. Unfinished Threaded Fasteners: ASTM A 307, Grade A, regular low-carbon steel bolts and nuts.

   1. Provide hexagonal heads and nuts for all connections.

G. High-Strength Threaded Fasteners: Heavy hexagon structural bolts, heavy hexagon nuts, and hardened washers, as follows:

1. Quenched and tempered medium-carbon steel bolts, nuts and washers, complying with ASTM A 325.

H. Electrodes for Welding: Comply with AWS Codes as indicated on Plans. Filler metal for welding shall conform to the requirements of the AWS, E70XX classification.

I. Structural Steel Primer and Topcoat Paint: Primer paint for building steel members shall be aromatic zinc rich urethane primer applied at 2.5 to 3.5 mils DFT. Topcoat Paint shall be an epoxy mastic applied at 4.0 to 6.0 mils DFT. Provide one of the following products for each:

1. Primer
   a. Tnemec 394 - Omni-Thane zinc rich urethane primer
   b. E.I. du Pont Ganicin 2.8MCZ
   c. Hemple 1649 Hemple Zinc HS
   d. Or approved equal

2. Topcoat
   a. Tnemec 27 WB Typoxy
   b. E.I. du Pont Corlar 2.1-PR
   c. Hemple Hempadur 45880
   d. Or approved equal

J. Galvanizing shall be in accordance with ASTM A123. Touch-up for galvanized surfaces: Galvanizing paint repair shall be ZRC Cold Galvanizing Compound by ZRC World Wide, ZiRP by Duncan Galvanizing, Brite Zinc as manufactured by Brite Products or approved equal and shall conform with the requirements of ASTM A780, with 95 percent zinc by weight.

K. Cement Grout: Portland cement (ASTM C 150, Type I or Type III) and clean, uniformly graded, natural sand (ASTM C 404, Size No. 2). Mix at a ratio of 1.0 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

1. Non-Metallic Shrinkage-Resistant Grout: Pre-mixed, non-staining, non-corrosive, non-shrink, non-metallic cement based grout complying with ASTM C1107, "Grade C", *Standard Specification for Packaged Dry Hydraulic Grout - Non Shrink.*

   a. Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following or approved equal:

      1) Five Star Grout; Five Star Products Inc.

      2) Crystex; L&M Construction Chemicals

      3) Masterflow 555; Master Builders

L. Stainless Steel Threaded Rods shall meet the requirements of ASTM A193 B7 or AISI 316 for stainless steel rods.

M. Canopy Support Items:

1. Rod: Type 316 stainless steel cold head fittings.
2. Tensions: Type 316 stainless steel turnbuckles.
3. Accessories: Grommets, bushings and washers: Synthetic material.
4. Typical Fittings for each length of cable shall be stainless steel swageless assembly with 540 tensioner and N20 fork terminal by Seco South or approved equal, with deckeye fastener where required.

2.2 FABRICATION

A. Shop Fabrication and Assembly: Fabricate and assemble structural assemblies in shop to greatest extent possible. Fabricate items of structural steel in accordance with AISC Specifications for building steel, and as indicated on final shop drawings with the modifications and additional requirements specified in this Section.

1. Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence which will expedite erection and minimize field handling of materials.

2. Where finishing is required, complete assembly, including welding of units, before start of finishing operations. Provide finish surfaces of members exposed in final structure free of markings, burrs, and other defects. Welds shall be finished flush and smooth.

B. Connections: Weld or bolt shop connections, as indicated.

1. Bolt field connections, except where welded connections or other connections are indicated.

a. Provide 3/4" diameter high-strength threaded fasteners for principal bolted connections, except where unfinished bolts are indicated.

b. Diameter of holes in bolted parts shall be 1/16" greater than the nominal diameter of the bolt. No unfinished holes will be accepted, and enlargement of holes shall not be accomplished by burning. Burrs resulting from drilling or punching shall be ground to the surface of the material. Shearing and punching shall be done cleanly so as not to deform or mar adjacent surfaces.

2. Eccentric connections shall be avoided if possible. Where necessary, care shall be taken that all shears, tensions and connections provided by eccentricities are amply provided for in connections and that harmful additional stress are not introduced into members.

C. High-Strength Bolted Construction: Install high-strength threaded fasteners in accordance with AISC "Specifications for Structural Joints using ASTM A 325 or A 490 Bolts" (RCRBSJ).

1. Bolts which have been completely tightened shall be marked with an identifying symbol.

2. The tightening of the bolts with other than calibrated wrenches will not be permitted. Contractor shall submit to Designer a certification that the calibrating device for setting the calibrated wrenches for high-strength bolts has been checked by the testing laboratory. If at any time during construction the Designer has reason to question the accuracy of the calibrating setting device, he may, at his option, require that the machine be sent back to the Contractor for certification of its accuracy by the testing laboratory. In any case, the calibrating setting device must be checked for accuracy after each six-month period of use on the project, and proof of certification must be submitted to the Designer.

3. In all cases on non-parallel abutment surfaces, the nut shall be torqued against a non-sloping surface.

4. High strength bolts shall have a hardened washer under the element (nut or thread) turned in tightening. Beveled washers shall be provided in all bolt connections to sloping flanges of American Standard beams and channels.

5. High strength bolts once tightened shall not be loosened and re-used.

D. Welded Construction: Comply with AWS Codes for procedures, appearance and quality of welds, and methods used in correcting welding work.

1. Assemble and weld built-up sections by methods which will produce true alignment of axes without warp.

E. Holes for Other Work: Provide holes required for securing other work to structural steel framing, and for passage of other work through steel framing members, as shown on final shop drawings.

1. Provide threaded nuts welded to framing, and other specialty items as indicated to receive other work.

2. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame cut holes or enlarge holes by burning. Drill holes in bearing plates.

2.3 SHOP PAINTING

A. General: Shop paint structural steel including those members or portions of members to be embedded in concrete or mortar.

1. Do not paint surfaces which are to be welded. High-strength bolted locations with friction-type connections may be painted using a slip critical primer as specified.

2. Apply 2 coats of paint to surfaces which are inaccessible after assembly or erection.

3. Apply specified coats in paragraph 2.1 I. to all steel embedded into masonry or foundation concrete and steel columns encased in concrete, unless galvanizing is indicated.

B. Surface Preparation: After inspection and before shipping, clean steel work, to be painted. Remove loose rust, loose mill scale, and spatter, slag or flux deposits. Clean steel in accordance with Steel Structures Painting Council (SSPC) as follows:

1. For building steel members: SP-6 "Commercial Blast Cleaning".

PART 3 - EXECUTION

3.1 INSPECTION

A. Erector must examine areas and conditions under which structural steel work is to be installed, and notify Contractor in writing of conditions detrimental to proper and timely completion of

work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to the Erector.

3.2 ERECTION

A. Surveys: Employ a registered professional engineer or land surveyor for accurate erection of structural steel. Check elevations of concrete bearing surfaces, and locations of anchor bolts and similar devices, before erection work proceeds, and report discrepancies to the Designer. Do not proceed with erection until corrections have been made, or until compensating adjustments to structural steel work have been agreed upon with the Designer.

B. Temporary Shoring and Bracing: Provide temporary shoring and bracing members with connections of sufficient strength to bear imposed loads. Remove temporary members and connections when permanent members are in place and final connections are made. Provide temporary guy lines to achieve proper alignment of structures as erection proceeds.

C. Anchor Bolts: Furnish anchor bolts and other connectors required for securing structural steel to foundations and other in-place work.

1. Furnish templates and other devices as necessary for presetting bolts and other anchors to accurate locations.

2. Refer to Division 3 and Division 4 of these specifications for anchor bolt installation requirements in concrete.

D. Setting Bases and Bearing Plates: Clean concrete bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean bottom surface of base and bearing plates.

1. Set loose and attached base plates and bearing plates for structural members on wedges or other adjusting devices.

E. Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims, but if protruding, cut off flush with edge of base or bearing plate prior to packing with grout.

F. Pack grout solidly between bearing surfaces and bases or plates to ensure that no voids remain. Finish exposed surfaces, protect installed materials, and allow to cure.

1. For proprietary grout materials, comply with manufacturer's instructions.

G. Field Assembly: Set structural frames accurately to lines and elevations indicated. Align and adjust various members forming part of complete frame or structure before permanently fastening. Clean bearing surfaces and other surfaces which will be in permanent contact before assembly. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure within specified AISC tolerances.

2. Establish required leveling and plumbing measurements on mean operating temperature of structure. Make allowance for difference between temperature at time of erection and mean temperature at which structure will be when completed and in service.

3. Splice members only where indicated and accepted on shop drawings.

H. Erection Bolts: On exposed welded construction, remove erection bolts, fill holes with plug welds and grind smooth at exposed surfaces.

I. High Strength Bolts: Installation shall be performed by using pneumatic powered impact wrenches with sufficient capacity and on adequate supply of compressed air, or installation shall be performed in accordance with the turn-of-the-nut method outlined in the AISC "Specification for Structural Joints using ASTM A-325 or A 490 Bolts", with the following modification:

1. Use a hardened washer under either the bolt head or nut, whichever is turned in tightening.

J. Welding: Field welding shall be executed in accordance with all requirements of AWS. All field welding shall be done by manual shielded metal-arc welding, only.

1. All groove welds shall be continuous and full penetration welds unless otherwise shown on the design plans. Welds made without the aid of a backing shall have their roots chipped, ground or gouged out to sound metal from the second side, before welding is done from the second side.

K. Comply with AISC Specifications for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.

1. Do not enlarge unfair holes in members by burning or by use of drift pins, except in secondary bracing members. Ream holes that must be enlarged to admit bolts.

L. Gas Cutting: Do not use gas cutting torches in field for correcting fabrication errors in primary structural framing. Cutting will be permitted only on secondary members which are not under stress, as acceptable to Designer. Finish gas-cut sections equal to a sheared appearance when permitted.

M. Touch-Up Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint. Apply primer and topcoat paints to exposed areas on perimeter columns and spandrel beams, using same materials as used for shop painting.

1. Apply by brush or spray to provide minimum dry film thickness as specified for shop painting.

N. Galvanizing: All steel indicated to be “galvanized” shall be cleaned and hot dipped galvanized in strict accordance with ASTM A123.

3.3 QUALITY CONTROL

A. The Contractor shall employ and pay an independent testing and inspection agency to perform all specified testing, and to submit full reports of each test conducted. The testing agency shall be responsible for interpreting the results of each test, and shall state in each report whether or not the test specimens comply with the specified requirements, and shall include any deviation therefrom. Test results will be reported in writing to Designer within 24 hours after tests.

1. Testing agency shall conduct and interpret tests and state in each report whether test specimens comply with requirements, and specifically state any deviations therefrom.

2. Provide access for testing agency to places where structural steel work is being fabricated or produced so that required inspection and testing can be accomplished.

3. Testing agency may inspect structural steel at plant before shipment; however, Designer reserves the right, at any time before final acceptance, to reject material not complying with specified requirements.

B Welded Connection Testing:

1. Visually inspect all welds for size, length, and location in accordance with AWS D1.1. Measure and record the size and length of 25 percent of all welds at random locations.

2. Test 25 percent of all fillet welds at random locations by magnetic particle testing in accordance with ASTM E709.

3. Test 100 percent of all full or partial penetration welds by ultrasonically testing in accordance with AWS D1.1 and ASTM E164.

C. Bolted Connection Testing:

1. Visually inspect all bolted connections for bolt and nut size and grade, and for snug contact of all connected elements in accordance with AISC Manual of Steel Construction.

2. Test 25 percent of bolts (but not less than 2 bolts) in each connection by calibrated torque wrench in accordance with AISC Manual of Steel Construction.

D. Correct deficiencies in structural steel work which inspections and laboratory test reports have indicated to be not in compliance with requirements. Perform additional tests, at Contractor's expense, as may be necessary to reconfirm any non-compliance of original work, and as may be necessary to show compliance of corrected work.

3.4 CLEAN-UP

A. All work provided under this Section shall be cleaned of all oil, dirt, debris, and other foreign materials, and shall be ready to receive any scheduled finish coating, or attachment or other systems specified elsewhere.

B. The Contractor providing the Work of this Section shall maintain the effected work area neat and clean at all times.

END OF SECTION 05 10 00

SECTION 07 14 00 - FLUID APPLIED WATERPROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies furnishing and installing of a methyl cold spray applied, seamless elastomeric waterproofing system as shown on the drawings. Work shall include the following:

1. Blind side waterproofing at all pit perimeter walls.

2. On mud mats and/or concrete construction base slabs below independent wheel true facility structure concrete floor slab and below entire building floor slab.

1. 2 RELATED WORK SPECIFIED ELSEWHERE

A Carefully examine all of the Contract Documents for requirements which affect the work of this section.

B. Other specifications sections which directly relate to the work of this section include, but are not limited to, the following:

1. Section 03 30 00 - Cast-In-Place Concrete.
2. Section 07 14 16 – Cold Fluid Applied Waterproofing

1.3 QUALITY ASSURANCE

A. General: Obtain primary materials from a single manufacturer for each product specified. The Manufacturer shall have a minimum of 10 years experience in the production, sales, and technical support of seamless waterproofing membranes and related materials and meet all requirements specified herein. Manufacturers shall submit a list of projects of similar design and complexity completed within the past 3 years. Provide secondary materials which are acceptable to the manufacturers of the waterproofing materials.

B. Installer Qualifications: A firm which has specialized for not less than 3 years in installation of types of waterproofing required for this project and which is acceptable to manufacturer of waterproofing materials.

C. Subdivision of Work: To limit responsibility, assign all work related to waterproofing, including, but not limited to, flashings, joint fillers and sealers, surface preparation, protection courses and the like to the waterproofing installer.

D. Pre-Installation Meeting: A pre-installation meeting shall be held prior to commencement of field operations to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work. Agenda for meeting shall include review of special details and flashing.

1.4 DELIVERY, STORAGE AND HANDLING

A. Refer to Form 816 Article 1.06.03 and Form 816 Article 1.20-1.06.03 for additional information.

B. Each container shall be delivered to the site with unbroken seals and shall bear label of the manufacturer. Protect from damage from sunlight, weather, excessive temperatures and construction operations. The applicator shall be provided with a storage area for all components.

The area shall be cool, dry and out of direct sunlight and in accordance with manufacturer recommendations and relevant health and safety regulations. Materials not conforming to this requirement will be cause for rejection by the Engineer and shall be removed from the site and replaced with approved materials at the Contractor's expense.

1. Do not double stack pallets of waterproofing materials on the job site. Provide cover on top and sides, allowing for adequate ventilation.

2. Store protection board flat and off ground. Provide cover on top and sides.

3. Copies of Material Safety Data Sheets (MSDS) for all components shall be kept on site for review by the Engineer and/or other personnel.

C. Sequence deliveries to avoid delays, but minimize on-site storage.

1.5 SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR - SUBMITTALS.

B. Product Data and Shop Drawings: Prior to ordering waterproofing materials, the Contractor shall submit the items listed below to the Designer for approval:

1. 3 copies of Manufacturer's specifications for proposed products and installation instructions.

2. Written approval of Manufacturer's use of the products in the proposed system.

3. Specimen copy of membrane Manufacturer's warranty.

4. Dimensioned shop drawings indicating areas of work, membrane layout and profile details of flashing methods for conduit or utility hangers, penetrations and terminations.

C. Samples:

1. Provide samples of each material to be used in the systems described herein, including primers, insulation, sheet goods, mastics, tapes, and fluid applied waterproofing.

D. Quality Assurance Submittals:

1. Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR - POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.
2. Source quality-control test reports.
3. Field quality-control test reports.

1.6 JOB CONDITIONS

A. Substrate: Proceed with waterproofing work only after substrate preparation and penetrating work is complete and in condition to receive work of this section. Beginning of installation means Installer accepts substrates and conditions.

B. Weather: Proceed with waterproofing work only when existing and forecasted weather conditions will permit work to be performed in accordance with manufacturer's recommendations. Application can proceed while air and substrate temperatures are between 14^{o}F and 120^{o}F providing the substrate is above the dew point. Outside of this range, the manufacturer shall be consulted.

C. Environmental Requirements:

1. All components of the waterproofing system shall comply with applicable Volatile Organic Compound (VOC) regulations.

1.7 WARRANTY

A. Refer to Form 816 Article 1.20-1.06.08 and NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.

B. Warranty shall be by the manufacturer of the waterproofing system.

C. Warranty period shall be for 10 years from date of issuance of Certificate of Compliance for the fluid applied elastomeric membrane waterproofing material.

1.8 MANUFACTURER'S REPRESENTATIVE

A. The contractor shall obtain the services of the waterproofing manufacturer's technical representative to inspect the work for acceptable substrate conditions and to monitor membrane installation on a full time basis during the initial installation period, and once a week thereafter until completion of the waterproofing work.

PART 2 - PRODUCTS

2.1 MATERIALS AND PRODUCTS

A. Fluid Applied Waterproofing: Fluid-Applied Waterproofing Membrane shall be 100% solvent free spray-applied material. Acceptable manufacturers include:
   a. Grace Construction Products, Grace Procor,
   b. CETCO, Liquid Boot,
   c. Or approved equal.

B. Where membrane is applied directly onto concrete or steel, the system shall include a methyl methacrylate primer that enhances the adhesive bond between the substrate and membrane.

1. The membrane shall meet or exceed the following properties as related to laboratory-prepared samples tested at 68°F (20°C) and 24-hour cure where applicable:

Property	**Test Method**	**Units**
Gel Time	-	6-11 minutes
Cure Time	-	30 minutes
Water Vapor Transmission	ASTM E96-100 Method A	1.048 g/m^2/day
Adhesion to Concrete	ASTM D4541	100 psi or failure of concrete
Minimum Tensile Strength	ASTM D638-91, Method A, Die C	1,700 psi
Min. Elongation at Break	ASTM D638, Method A, Die C	130%
Low Temp. Flexibility	CAN CGSB 37.50 M89	Pass 1/4" mandrel at -13°F

Property	Test Method	Units
Crack Bridging	ASTM C836-00	Pass @ 10 cycles, 1/8 inch - 15° F

2. Protection board shall be required if so noted by the manufacturer.

C. Miscellaneous Materials: Tape and other accessories specified or acceptable to manufacturer of fluid applied waterproofing membrane.

D. Insulation: Two-inch polystyrene insulation unless thickness noted otherwise on the Drawings.

PART 3 - EXECUTION

3.1 INSPECTION

A. The Installer/Erector shall examine substrates, supports, and conditions under which this work is to be performed and notify the Designer, in writing, of conditions detrimental to the proper completion of the work. Do not proceed with work until unsatisfactory conditions are corrected. Commencement of application of waterproofing to any surface will be construed as acceptance of that surface as proper to receive the waterproofing, and any defects in the work thereafter, except for structural cracks, shall be the responsibility of this trade.

B. The following tests shall be conducted by the Applicator or Manufacturer's representative and recorded on a form to be submitted to the Designer.

1. Temperature: Air, substrate temperature and dew point.

2. Membrane Thickness: Wet film thickness shall be checked every 100 SF.

3. Coverage Rates: Before spraying, the area to be applied shall be clearly marked out to indicate quantity of material used against the area covered.

3.2 SUBSTRATE PREPARATION FOR WATERPROOFING

A. Surfaces shall be free of oil, grease, curing compounds, loose particles, moss, algae growth, laitance, friable matter, dirt, bituminous products, and previous waterproofing materials. If required, de-greasing shall be performed via detergent washing in accordance with ASTM D4258.

B. Where membrane system is applied directly onto concrete, concrete surfaces shall be abrasively cleaned, in accordance with ASTM D4259, to provide a sound substrate free from laitance.

C. Insulation installation: Insulation shall be laid over mud slab and fixed to the inside form work of the wheel true pit wall locations per membrane manufacturer's recommendations.

3.3 MEMBRANE INSTALLATION

A. Strictly comply with manufacturer's instructions and recommendations, except where more restrictive requirements are specified in this section.

B. Application of fluid applied waterproofing:

1. The system shall be applied in three or four distinct steps as listed below:

a. Substrate preparation
b. Priming (areas where membrane is applied directly onto concrete)
c. Insulation application
d. Membrane application

2. Immediately prior to the application of any component of the system, the surface shall be dry and any remaining dust or loose particles shall be removed using clean, dry, oil-free compressed air or industrial vacuum.

3. Where the area to be treated is bound by a vertical surface (e.g. curb or wall), the system may be continued up the vertical as necessary.

4. In locations that utility pipes or other components penetrate the floor slab, apply waterproofing, tape, collars and hydrophilic water stops in accordance with the Manufacturer's recommendations or as approved by the Designer or directed by the Engineer.

5. The handling, mixing, and addition of components shall be performed in a safe manner to achieve the desired results in accordance with the Manufacturer's recommendations or as approved by the Designer or directed by the Engineer.

6. A neat finish with well-defined boundaries and straight edges shall be provided by the Applicator.

7. Membrane:

   a. The waterproofing membrane shall consist of two coats with contrasting colors for quality control, to achieve a total thickness of 90 mils minimum.

      1) Application with insulation directly over the membrane shall be applied at 40 mils minimum per coat.

      2) Application with concrete poured directly over the membrane shall be applied with the 1st coat at 60 mils and the 2nd coat at 40 mils. Immediately after application of the second coat and while it is still wet and ungelled, an Aggregate of size equivalent to Indag #8 approved by the waterproofing manufacturer shall be broadcast to fall vertically into the surface of the membrane to cover 70-80% of the exposed area. When the membrane is fully cured, all loose and excess aggregate must be removed from the surface by compressed air or vacuum

   b. The membrane shall be comprised of liquid components and a hardener which is to be added in accordance with the Manufacturer's recommendations.

   c. The substrate shall be coated in a methodical manner. Checks for wet film thickness shall be carried out typically once every 100 ft^2.

   d. To test waterproofing membrane for pinholes and deficiencies, upon completion of 2nd coat, the entire surface of the membrane shall be "holiday tested" in accordance with ASTM D 4787 using an approved holiday tester. Holiday testing equipment shall be independently calibrated with valid certification. In accordance with ASTM D-4787, voltage shall be set at the NACE recommended voltage of 100 volts per mil. All holidays shall be located, marked for repair, documented, and repaired in accordance with the membrane manufacturer's recommendations. Repaired areas shall meet the total thickness requirements previously specified.

8. Repairs:

   a. If an area is left untreated or membrane becomes damaged, a patch repair shall be carried out to restore the integrity of the system. The damaged area shall be cut back to sound material and wiped with solvent (e.g. acetone) up to a width of at least 4 in. on the periphery, removing the tack coat and any contaminants. The substrate shall be primed as necessary, followed by the application of membrane. A continuous layer shall be obtained over the substrate with a 4 in. overlap onto the existing membrane.

   b. Where the membrane is to be joined to existing cured material and at day joints, the new application shall overlap the existing one by at least 4 in. No preparation shall be necessary unless the existing materials are contaminated with tack coat or dirt in which case the repair/overlap shall first be wiped with solvent (e.g. acetone).

END OF SECTION 07 14 00

SECTION 07 54 00 - THERMOPLASTIC MEMBRANE ROOFING

PART 1 - GENERAL

1.1 SUMMARY:

A. The work of this section includes, but is not limited to, furnishing and installation of the following:

1. Mechanically attached, FM Global (FM) approved, PVC membrane roof system.
2. Flashing membrane, penetration boots, adhesives, membrane welding equipment, and related accessories required for a complete installation.
3. Sheet metal roof flashings, metal fascia termination, base and counter flashing and associated protective flashings.
4. Furnishing and installation of wood blocking.
5. Membrane walkway pads and concrete pavers.
6. Gutters, downspouts and downspout boots.

1.2 RELATED WORK SPECIFIED ELSEWHERE:

A. Carefully examine all of the Contract Documents for requirements which affect the work of this section.

B. Other specifications sections which directly relate to the work of this section include, but are not limited to, the following:

1. Section 06 10 00 - Rough Carpentry; preservative treated wood nailers.
2. Section 07 60 00 - Flashing and Sheet Metal; roof flashing terminations.
3. Section 07 61 00 - Sheet Metal Roofing; standing seam roofing.
4. Section 07 72 00 - Roof Accessories.
5. Section 07 92 00 - Joint Sealants
6. Division 22 - Plumbing; roof drains, furnished and set.
7. Section 23 74 13 – Packaged Outdoor Central Station Air Handling Units (with prefabricated roof curbs.

1.3 QUALITY ASSURANCE:

A. Installer: The Roofing Contractor shall submit written evidence that he/she has not less than five (5) years experience in the application of mechanically fastened membrane roofing systems using the materials of the manufacturers proposed for this project, including a statement from the roofing materials manufacturer that roofer is certified by the manufacturer for the application of the specified roofing materials. Certification by roofing materials manufacturer shall have been granted prior to bid by Roofing Contractor.

B. Pre-Installation Meeting: A site meeting shall be held with representatives of the Contractor, Designer, Roofing and Flashing Contractor, Roofing Materials Manufacturers and the Department’s Testing Laboratory Three days prior to the start of roofing work to inspect substrata and review installation requirements.

a. Pre-Installation Meeting shall be in compliance with the requirements of Form 816 Article 1.20-1.05.24 subsection 2.

C. Upon completion of the installation, and at appropriate intervals during installation, an inspection shall be made by a representative of the manufacturer to ascertain that the roofing systems have been installed according to applicable manufacturer's specifications and details.

D. Obtain current versions of FM Global requirements, data sheets, applications, and certification forms as required directly from FM Global.

1.4 ROOF SYSTEM REQUIREMENTS:

A. The Roofing Contractor shall submit evidence that the proposed roofing systems will meet the identified requirement of the following recognized insurance or testing agencies. These requirements are minimum standards and no roofing work shall commence without written documentation of the system's compliance, as required in the "Submittals" section of this specification.

1. Factory Mutual Insurance Company - Norwood, MA

a. F.M. Class I System acceptance
b. F.M. 1-105 wind uplift resistance, F.M. Data Sheet 1-7
c. F.M. Data Sheet 1-28 and 1-29
d. F.M. 1-150 for the 6ft perimeters and class 1-210 for the corners
e. F.M. RoofNav Website

2. Underwriters Laboratories - Chicago, IL

a. U.L. Class A membrane

1.5 SUBMITTALS:

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR - SUBMITTALS.

B. Certificates:

1. Statement from the roofing materials manufacturer that the roof applicator was certified by the manufacturer for the application of the specified roofing materials prior to the bid date of this Contract.
2. Written certification (in time to prevent delay in work) by the producer of roofing and insulation materials that all materials supplied comply with all requirements of the appropriate ASTM Standards, and that all the materials are suitable for the specified roofing system(s).

C. Samples and Shop Drawings:

1. Samples, in duplicate, of all materials specified, each properly labeled.
2. Shop Drawings:

a. Metal flashing, showing exact profile, lengths, joints, terminations and methods of attachment.

b. Membrane and elastomeric flashing details.
c. Complete layout of insulation and membrane systems.
d. FM Global submittal forms for the roofing system.

D. Manufacturer's Literature: Latest edition of acceptable manufacturer's roofing and base flashing specifications selected.

E. Warranties: Copy of membrane manufacturer's warranty. Copy of applicators warranty.

F. Completed FM Global “Application for Acceptance of Roofing System” form No. 2688.

G. Manufacturer’s Certificate: Certify that the roof system furnished is approved by Factory Mutual in accordance with ASTM E108, Class [A] for external fire and meets local or national recognized building codes.

H. Manufacturer’s Certificate: Certify that the roof system is fastened properly to meet or exceed the requirements of FM [I-105].

I. Quality Assurance Submittals:

1. Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR - POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.
2. Source quality-control test reports.
3. Field quality-control test reports.

1.6 DELIVERY, STORAGE AND HANDLING:

A. Refer to Form 816 Article 1.06.03 and Form 816 Article 1.20-1.06.03 for additional information.

B. Deliver materials and products in unopened factory labeled packages. Store and handle in strict compliance with manufacturer's instructions and recommendations. Protect from damage.

C. Handle all materials to avoid damage. Store rolled goods as directed by manufacturer. Discard rolls which have been flattened, creased, or otherwise damaged. Bonding adhesive shall be stored at temperatures above 40°F.

D. All flammable materials shall be stored in a cool dry area away from sparks and open flames. Follow precautions outlined on containers or supplied by material manufacturer/supplier.

E. Do not allow materials or incomplete roofing work to be exposed to moisture, anywhere, at any time, during transportation, storage, handling or installation. Use pallets and canvas tarpaulins (not polyethylene) to cover all stored material, top to bottom.

1.7 PROJECT CONDITIONS:

A. Weather: Perform work only when existing and forecasted weather conditions are within the limits established by manufacturers of the materials and products used.

B. Only as much of the new roofing as can be made weather-tight each day including all flashing work, shall be installed.

C. All work shall be scheduled and executed without exposing the interior building areas to the effects of inclement weather.

D. All surfaces to receive new insulation, membrane or flashings shall be thoroughly dry. Should surface moisture occur, the Contractor shall provide the necessary equipment to dry the surface prior to application.

E. Temporary water stops shall be installed at the end of each day's work, and shall be removed before proceeding with the next day's work. Waterstops shall be compatible with all materials and shall not emit dangerous or incompatible fumes. Provide waterstops for all roofing systems described in this specification per manufacturer's recommendations.

F. The Contractor shall provide all necessary protection and barriers to segregate the work area and to prevent damage to adjacent areas. Plywood protection shall be provided for all new roofing areas which will receive traffic during construction.

G. Prior to and during application, all dirt, debris and dust shall be removed from surfaces either by vacuuming, sweeping, blowing with compressed air and/or similar methods.

H. Membranes and accessories shall not be exposed to prolonged temperature in excess of 160°F.

I. Contaminants, such as grease, fats, oils and solvents, shall not be allowed to come into direct contact with the roofing membrane. Any unusual exposures shall be presented to the membrane manufacturer for assessment of any impact on the roofing membrane.

1.8 WARRANTY:

A. Refer to Form 816 Article 1.20-1.06.08 and NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.

B. Roofing systems shall be warranted to the Department by Roofing Membrane Manufacturer for a period of twenty (20) years commencing with the issuance of the Certificate of Compliance.

1. The Roofing System Supplier will repair any leaks in the system caused by defects in the materials supplied or in the workmanship of the Supplier's Authorized Roofing Applicator.

C. The Roofing and Flashing Contractor, as a condition precedent to final payment, shall execute his own written guarantee direct to the Department, warranting all roofing, base flashing and sheet metal work weather and water tight and perfect for a period of three years after date of issuance of the Certificate of Compliance. Any imperfections as a whole or in part, by reason of defective materials, workmanship or arrangement of the various parts shall be made good to the satisfaction of the Department at the Contractor's expense.

1.9 COORDINATION:

A. Pre-Bid Meeting: A pre-bid meeting will be held with a representative of the Department and involved trades to discuss all aspects of the project. The applicator's field representative or roofing foreman for the work shall be in attendance. Procedures to avoid rooftop damage by other trades shall be determined.

B. Site Visit: Bidders shall visit the site and carefully examine the area in question as to conditions which may affect proper execution of the work. All dimensions and quantities shall be

determined or verified by the Contractor. No claims for extra costs will be allowed because of lack of full knowledge of the existing conditions unless agreed to in advance with the Department or Department's representative.

1.10 SCAFFOLDS AND HOISTING:

A. Furnish and maintain all scaffold and mechanical hoisting equipment and provide operating personnel and all required rigging for the work specified herein.

PART 2 - PRODUCTS

2.1 MECHANICALLY ATTACHED PVC MEMBRANE SYSTEM

A. Membrane: .060 inch thick, Sarnafil® S327 polyester reinforced membrane with a lacquer coating, 10 feet wide by appropriate length as manufactured by Sika Sarnafil, or approved equal which conforms to the following physical properties:

1. Membrane shall conform to ASTM D4434 (latest version), "Standard for Polyvinyl Chloride Sheet Roofing," Classification: Type III and shall meet of exceed the following physical properties:

Parameters	ASTM Test Method	Typical Physical Properties
a. Color		EnergySmart (white)
b. Overall thickness	D751	0.060 inches
c. Breaking strength	D751	230 lbf/in
d. Shore A Hardness	D-2240	82
e. Elongation at break, min	D751)	20%
f. Seam strength*, min. (% of breaking strength)	D751	85
g. Tearing Strength min.	D1004	50 lbf.
h. Brittleness Test	D2137	Pass
i. Linear Dimensional Change	D1204	0.1%
j. Weight Change After Immersion in Water	D570	2.5%
k. Accelerated Weathering Test	G154	Pass
l. Static Puncture Resistance, 33 lbf	D5602	Pass
m. Dynamic Puncture Resistance, 14.7 ft-lbf	D5635	Pass

* Failure occurs through membrane rupture not seam failure.

B. Insulation:

1. Tapered extruded polystyrene supplied by Dow, UC Industries, Amoco or approved equal. Insulation shall be provided in thicknesses indicated on drawings to provide aged R value of 30 for entire roof system with minimum compressive strength of 25 psi. Assembled system shall have a slope of no less than 1/4 inch per foot with a starting thickness at the drains of 6 inches which shall provide the desired "average" U-factor through the completed roof construction. All insulation shall be manufactured without the use of CFC-11 as a blowing agent. All flat or filler insulation shall be identical to tapered panels. Provide a minimum slope of 1/4 inch per foot.

2. Crickets at Rising Walls and Hatches: Provide compatible tapered insulation to obtain design pitch.

C. Insulation Fasteners:

1. Fasteners for steel deck shall be buttress threaded fasteners with a minimum of 14 threads per inch, acceptable to membrane manufacturer and having a minimum penetration of 3/4 inch. Fasteners shall be installed in top flutes of the metal deck with minimum pullout resistance of 425 pounds. Fasteners shall be coated with a corrosion resistant coating equal to Stalgard Buildex or approved equal.

2. Fastening Plates: Provide Membrane manufacturer recommended fastening plates to secure insulation.

3. Compliance: Fasteners and fastening plates incorporated in roofing system shall conform to FM 4470 standard and DIN 50018 specification for corrosion resistance.

D. Overlayment Board: Overlayment board shall be non-structural fiberglass faced, silicone treated core gypsum panel; minimum 5/8 inch Dens-Deck and ½ inch Dens-Deck Prime Overlayment as manufactured by Georgia Pacific or approved equal. Board shall be applied over steel deck and insulation surfaces in one layer.

E. Sheet Air Infiltration Barrier: At membrane roof assemblies provide a 3 ply vapor retarder/air barrier equal to Griffolyn TX-1200 as manufactured by Reef Industries, Inc. or approved equal from Alumiseal or Raven Industries.

F. Flashing Adhesives and Sealants:

1. Adhesives: Contact adhesive as recommended by membrane manufacturer for attaching membrane to flashing substrate on this job. Application rates shall be in compliance with manufacturer's recommendations for intended substrate.

2. Sealant: As recommended by membrane manufacturer, color to match membrane.

3. Sealant at Pan pockets: Self - leveling polyurethane, GACO UWM-285, Two-part urethane as manufactured by Gates Engineering Co., Inc. or approved equal.

G. Elastomeric Flashing:

1. Base flashing shall be compatible with sheet membrane as supplied by membrane manufacturer.

2. Pipe seals and prefabricated flashing accessories shall be as supplied by membrane manufacturer.

3. Molded Pipe Flashing: Compatible with materials with which it is used, furnished by membrane manufacturer.

H. Prepunched Bar Fastener: An FM approved 14 gauge galvanized U-shaped steel bar with rolled edges and slotted holes punched 1 inch on center for membrane securement at bases of walls and curbs and as perimeter clamping bar for roof assemblies.

I. Metal Flashing:

1. Preformed Coping Cap: Preformed, prefinished permasnap coping system of 0.050 inch aluminum with concealed joint covers, coping chairs, and 16 gauge galvanized steel anchor cleat; normally 12 inches wide @ 5'-0" on center to be mechanically fastened as indicated and detailed with supplied fasteners. Style PCMC1100 by Hickman Construction Products or approved equal from MM Systems Corporation, Metal-Era or Roof Membrane manufacturer. Finish shall be custom color Kynar 500, Hylar 5000 as selected by the Designer. Roof edge system shall carry an FM I-105 approval.

2. Accessories: Provide all clips, cleats, straps, anchors and similar items necessary to properly complete the work. Provide accessories that are compatible with sheet metal materials used and which are of sufficient size and gage to perform as intended.

J. Accessory Products: The following products are supplied by membrane manufacturer and may be incorporated in this specification as needed or detailed on the drawings.

1. Walkway Pads: Polyester reinforced PVC membrane 0.096 inch thick for traffic areas.

2. Metal Clad Flashing: G-410L, .20 inch thick laminated to 25 gauge galvanized sheet steel.

3. Welding Equipment: Automatic hot air welding apparatus for seaming of sheets.

K. Miscellaneous Fasteners And Anchors: All fasteners shall be of the same type as metal being secured. In general all fasteners, anchors, nails, straps, shall be of zinc or cadmium plated steel, galvanized, or stainless steel. All fasteners and anchors shall have a minimum embedment of 1-1/4 inches and shall be approved for such use by the fastener manufacturer. Fasteners for attachment of metal to wood blocking shall be annular ring nails. Fasteners for attachment of metal to masonry shall be expansion type fasteners. All fasteners shall meet Factory Mutual Standard 4470 for corrosion resistance.

L. Wood Blocking:

1. Wood blocking at roof perimeters and penetrations shall be in profiles and sizes as indicated or required using dressed No. 2 kiln or commercial dried Hem-Fir pressure treated with preservatives in compliance with Section 06 10 00. Blocking shall be provided and installed at the perimeter of the entire roof and around other roof projections and penetrations. Thickness of nailers must match insulation board thickness to provide a smooth transition.

M. Roof Pavers:

1. 24 inch x 24 inch x ±2 inch architectural precast concrete pavers weighing minimum 30 lbs./sq. ft. Pavers shall have cast-in drainage channels to facilitate drainage.

2. Protection Layer: For walkways, a welded-in-place protection layer of Sarnafil membrane or approved equal is required under the concrete pavers.

2.2 GUTTERS, DOWNSPOUTS AND DOWNSPOUT BOOTS

A. Gutters: Gutters shall be formed from extruded 0.090" aluminum in a minimum 6" x 6" profile as manufactured by Southern Aluminum Finishing Company or approved equal from Hickman or

Metal-Era. Gutters shall be supplied with factory installed sleeves to accommodate joining and factory installed connector for the downspout connection. Heavy duty support brackets and internal straps shall be formed from 0.125" aluminum and spaced as recommended by the Manufacturer and approved by the Engineer. Gutters shall be finished with a fluoropolymer finish in color selected by Designer

B. Downspouts: Downspouts shall be formed from extruded 0.090" aluminum in 4" x 6" rectangular profile as manufactured by Southern Aluminum Finishing Company or approved equal from Hickman or Metal-Era. Rectangular downspouts shall be supplied with factory installed sleeves to accommodate joining. Provide SMACNA Type C Hangar/Wall Brackets which provide a positive standoff from the wall. The external strap and wall bracket are fastened together as well as to the downspout. Downspouts shall be finished with a fluoropolymer finish in color selected by Designer.

C. Rectangular Downspout Boot: Provide cast aluminum downspout boot for rectangular to round transition, model Type DS4 at locations requiring connection to the subsurface drainage system and model Type DS8 at locations requiring splash pads as manufactured by McKinley or approved equal from Neenah Foundry Company or Barry Pattern & Foundry Company, Inc. Finish shall match downspouts. Downspout boots shall be a minimum of 8 feet in length.

PART 3 - EXECUTION

3.1 GENERAL

A. The roofing Contractor shall coordinate the installation so that each area is made watertight at the end of each work period.

3.2 DECK PREPARATION

A. FM approved steel deck - The roof deck shall be 22 gauge (minimum) grade E and shall conform and be installed to meet the latest revision of FM's Loss Prevention Data Sheet 1-28 and the local code's current requirements. Substrate shall be provided to receive the membrane as a mechanically fastened system.

B. The roofing Contractor shall inspect the roofing surfaces for defects such as excessive surface roughness, contaminated surfaces, structurally unsound substrates, etc., that will adversely affect the quality of work.

C. The substrate shall be clean, smooth, dry, free of flaws, sharp edges, loose and foreign material, oil and grease. Roofing shall not start until all defects have been corrected.

D. Verify that the work of other trades which penetrates roof deck has been completed, and that nailers have been installed at perimeter and at vents, etc.

E. Remove all materials that could contain or include water.

F. Do not proceed with application of roofing until defects are corrected, and the surfaces have been approved by a representative of the membrane manufacturer.

3.3 INSTALLATION OF AIR BARRIER

A. Steel Roof Deck Substrates. Prior to installation of air/vapor barrier place 5/8 inch Dens Deck overlayment board in one layer over metal deck surfaces. At sloped roof locations or where temporary securement may be required use Dow Corning 795 silicone mastic or approved equal in ribbons applied to every other flute in serpentine pattern. Edges of board shall be butted snugly with no gaps between boards greater than 1/4 inch. Apply air barrier sheets over the clean and dry Dens-Deck material and secure using manufacturer's recommended adhesive. Sheet shall be pulled taught and tight with no wrinkles of air bubbles. All seams and protrusions shall be taped per manufacturer's written instructions.

3.4 WOOD BLOCKING INSTALLATION:

A. Install all wood blocking required by field conditions and as indicated on the drawings. Blocking shall be installed using approved non-corrosive fasteners spaced to resist uplift requirements of 75 pounds per linear foot. All blocking to receive bolts and/or screws shall be counter bored to provide the nut or screw head slightly below the top of wood surface.

B. Refer to drawings for all conditions necessary to complete the work. In the absence of details, blocking shall be provided in accordance with field conditions as approved by the Engineer and as recommended by the membrane manufacturer.

C. Provide all required expansion sleeves necessary for Engineer approved securement of blocking.

3.5 APPLICATION OF ROOF INSULATION

A. Verify all dimensions, drain heights and drain locations in the field prior to installation of the tapered or flat insulation systems.

B. Starting at low points lay tapered or flat insulation panels directly over Dens Deck overlayment board substrates and air barrier and in strict accordance with the layout pattern indicated on the approved shop drawings. All panels shall be butted snugly with no gaps greater than 1/4 inch. Gaps greater than 1/4 inch shall be filled with the same material.

1. Mechanically attach insulation to deck substrates in accordance with insulation manufacturers written recommendations, FM's and membrane Manufacturer’s recommendations for fastening rates and patterns.

C. Fill insulation shall be utilized in 1 inch increments as necessary to achieve the specified thickness and thermal values.

D. Install snubnose, full diamond, and kite crickets where required to provide the design pitch of 1/4 inch per foot.

3.6 APPLICATION OF OVERLAYMENT BOARD

A. Over the mechanically fastened tapered or flat insulation position the primed fiberglass faced, silicone treated core gypsum overlayment board. Overlayment board shall be positioned so that boards follow contours of insulation system with edges butted snugly with no gaps between boards greater than 1/4 inch. Overlayment board shall be installed in one minimum 1/2 inch layer.

1. Mechanically attach overlayment board through insulation and into steel decks in accordance with overlayment board manufacturer written recommendations and in compliance with roof membrane manufacturer recommendations. Fasteners shall not protrude excessively.

3.7 INSTALLATION OF MECHANICALLY ATTACHED PVC MEMBRANE

A. The surface of the insulation or substrate shall be inspected prior to installation of the roof membrane. The substrate shall be clean, dry, free from debris and smooth, with no surface roughness or contamination. Broken, delaminated, wet or damaged insulation boards shall be removed and replaced.

B. General:

1. The membrane shall be attached with manufacturer's recommended fasteners and discs according to manufacturer's and Factory Mutual requirements.

2. Membrane overlaps shall be shingled with the flow of water where possible.

3. Sarnabars or approved equal shall be fastened perpendicular to the direction of the steel deck flutes.

4. Tack welding of membrane full or half-width rolls for purposes of temporary restraint during installation on windy days is not permitted.

C. Perimeter and Corner Areas:

1. Over the properly installed and prepared substrate surface, Sarnabars or approved equal are to be installed on top of the membrane and parallel with the entire perimeter edge. The number of perimeter and corner Sarnabars will be determined by building height and width and other conditions according to FM guidelines and membrane Manufacturer's Technical Department. Sarnafasteners or approved equal are installed through the Sarnabar, through the membrane and into the roof deck or structural framing. Fasteners shall clamp the membrane tightly to the substrate. All Sarnabars shall be covered with a welded coverstrip above them for watertightness.

   a. Perimeter areas are defined as the outer boundary of the roof. If the roof is broken into different levels, each roof area shall be treated as an individual roof with its outer boundary being treated as a perimeter. Typically, internal expansion joints and firewalls; are not considered to be full perimeters.

   b. The ridge area is defined as the high point in the roof area formed by two intersecting planes. When the sum of the slopes is a minimum of 4 inches in 12 inches (30 degrees), each side of the ridge shall be treated as a perimeter area.

2. Hot-air weld overlaps according to manufacturer's requirements. Take test cuts at least 3 times per day.

D. Interior Area:

1. Over the properly installed and prepared substrate surface, Sarnabars or approved equal are to be installed on top of the membrane and perpendicular to the steel deck flutes. The spacing and fastening of Sarnabars will be determined by building height and width and other conditions according to FM guidelines and Manufacturer's guidelines. Sarnafasteners or approved equal are installed through the Sarnabar, through the membrane and into the roof

deck or structural framing. Fasteners shall clamp the membrane tightly to the substrate. All Sarnabars shall be covered with a welded coverstrip above them for water tightness.

2. Hot-air weld overlaps according to manufacturer's requirements. Take test cuts at least 3 times per day.

E. Securement around perimeter and rooftop penetrations:

1. At the base of walls, drains, curbs, vent pipes, or any other roof penetrations, Sarnafasteners, Sarnabars and/or Sarnadiscs or approved equal shall be installed according to perimeter rate of attachment. Fasteners shall be installed according to the manufacturer's instructions. Fasteners shall be installed using the fastener manufacturer's recommended torque-sensitive fastening tools with depth locators. Fasteners shall clamp the membrane tightly to the substrate.

2. Membrane flashings shall extend 2-1/2 inches past the Sarnabars and/or Sarnsdiscs and shall be hot-air welded to the deck membrane.

F. Hot Air Welding of Lap Areas: All welding, weather by hand or machine, shall be in compliance with Manufacturer's written instructions.

1. Adjacent sheets shall be welded in accordance with manufacturer's written instructions. All side and end lap joints shall be hot air welded. Lap areas shall be a minimum of 4 inch wide when hand welding.

2. Welding equipment shall be provided by or approved by the membrane manufacturer. All mechanics intending to use equipment shall have successfully completed a course of instruction provided by a membrane manufacturer's representative prior to welding.

3. All surfaces to be welded shall be clean and dry. No adhesive shall be present within the lap areas.

G. Membrane Flashing: All flashings shall be installed concurrently with the roof membrane as the job progresses. No temporary membrane flashing shall be allowed without the prior written approval of the membrane manufacturer. Flashing shall be adhered to compatible, dry, smooth, and solvent-resistant surfaces. Use caution to ensure adhesive fumes are not drawn into the building.

1. Manufacturer's requirements and recommendations and the specifications shall be followed.

2. All flashings shall extend a minimum of 8 inches above roofing level unless otherwise accepted in writing by the Engineer and Manufacturer's Technical Department.

3. All flashing membranes shall be consistently adhered to substrates. All interior and exterior corners and miters shall be cut and hot-air welded into place. No bitumen shall be in contact with the thermoplastic membrane.

4. All flashing membranes shall be mechanically fastened along the counter-flashed top edge with Sarnastop or approved equal at 6-8 inches on center.

5. All adhered flashings that exceed 30 inches in height or that of the perimeter Sarnabar spacings shall receive additional securement.

6. All mechanically-attached flashings that exceed 18 inches in height shall receive additional securement.

3.8 INSTALLATION OF METAL FLASHING

A. Metal details, fabrication practices and installation methods shall conform to the applicable requirements of the following:

1. Factory Mutual Loss Prevention Data Sheet 1-49 (latest issue).
2. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA) - latest issue.

B. General Installation Requirements:

1. The roofs shall be flashed and counter flashed and made watertight at all edges and intersections of roof with vertical surfaces of any nature. Fasten flanges and cleats as noted 4 inch on center unless otherwise specified or directed.

2. All aluminum flashing and sheet metal work shall be fabricated and placed in accordance with the best practices and applicable requirements and details of "SMACNA" Architectural Sheet Metal Manual and any additional requirements, as specified herein.

3. Generally, flashing and sheet metal work shall be in lengths not exceeding 10 feet and free from longitudinal joints. All flashing in contact with dissimilar metal shall be coated with asphalt paint. All joints in flashing shall be sealed with seam sealant and made watertight. Expansion joints shall be formed by joining ends of sheets together with a 3 inch loose lock, filled with elastic cement. Expansion joints shall be installed every 30 feet in straight runs; straight runs less than 30 feet shall have similar expansion joint at center of the run.

4. Reinforce all metal flashing corners as required. All joints must be waterproof with seam sealant.

B. Exposed Sheet Metal Work: Securely anchor sheet metal work, but allow for thermal movement and building movement. Use concealed fasteners to the greatest extent possible. Install work to be permanently weatherproof and watertight.

C. Reglets: Provide reglets where indicated and where needed to terminate flashings and counterflashings. Coordinate installation with related and adjacent work. Wedge sheet metal into reglets with lead wedges spaced not more than 16 inch o.c. and seal entire reglet with sealant as specified in Section 07 92 00 - Joint Sealants.

3.9 WALKWAY INSTALLATION

A. Walkways shall be provided for regular maintenance of roof top equipment and for roof areas subject to foot traffic where pavers are not indicated.

1. Walkway Pad Installation:

a. Roofing membrane to receive walkway pads shall be clean and dry.

b. Chalk lines on deck sheet to indicate location of walkway pads.

c. Apply a continuous coat of contact adhesive to the deck sheet at a rate of 3/4 gallon per 100 square feet. Keep adhesive back 3 inches from location lines (see step b) for hot air welding. Allow adhesive to completely dry.

d. Walkway pads shall be unrolled and positioned within chalk lines, then folded back on itself exposing the underside for one-half of its length.

e. A continuous coat of contact adhesive shall be applied to the underside of the walkway pad at a rate of 1/2 gallon per 100 square feet. Keep adhesive back 3 inches from the edge of the sheet for hot air welding. This adhesive shall be allowed to dry sufficiently to produce strings when touched with a dry finger. Do not allow adhesive to completely dry. The amount of membrane that can be coated with adhesive before rolling into substrate will be determined by ambient temperature, humidity, and manpower.

f. The coated walkway shall be rolled into the previously coated deck sheet, using care to avoid wrinkles.

g. The bonded walkway pad shall be pressed firmly in place with a weighted foam covered lawn roller.

2. Concrete Pavers

a. Weld the edges of a protection layer of G410 membrane in place. Place normal weight concrete pavers on the protection membrane. In areas of high wind exposure the pavers shall be strapped together with stainless steel metal straps that are flush with the paver surface. Do not run walkway over Sarnabars or approved equal.

3.10 COMPLETION

A. All guarantees, as required in Part 1 of this specification shall be submitted for approval prior to final payment.

END OF SECTION 07 54 00

SECTION 21 13 13 - WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Design , provide and test a wet pipe sprinkler system and appurtenances as specified

1.2 SUMMARY

A. Section Includes:

1. Pipes, fittings, and specialties.
2. Fire-protection valves.
3. Fire-department connections.
4. Sprinklers.
5. Alarm devices.
6. Pressure gages.

B. Related Sections:
1. Division 21 Section “Common Work Results for Fire Suppression
2. Division 21 Section “Facility Fire Suppression Water Service Piping
3. Division 21 Section "Dry-Pipe Sprinkler Systems" for dry-pipe sprinkler piping.
4. Division 21 Section "Electric-Drive, Centrifugal Fire Pumps" for fire pumps, pressure-maintenance pumps, and fire-pump controllers.

1.3 DEFINITIONS

A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175 psig maximum.

1.4 SYSTEM DESCRIPTIONS

A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included.

1.5 PERFORMANCE REQUIREMENTS

A. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

B. Delegated Design: Design sprinkler systems, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1. Available designed discharge pressure at the fire pump is 150 psi.

C. Sprinkler system design shall be approved by authorities having jurisdiction.

1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventer.
2. Sprinkler Occupancy Hazard Classifications: See drawings F5-111 and F5-112

3. Minimum Density for Automatic-Sprinkler Piping Design:

a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
c. Ordinary-Hazard, Group 2 Occupancy: 0.19 gpm over 2000-sq. ft. area. (2,600 sqft for dry pipe system).

4. Maximum Protection Area per Sprinkler:

a. Light Hazard: 220 sq. ft.
b. Ordinary Hazard: 130 sq. ft.

5. Hose-Stream Allowance:
a. Ordinary-Hazard Occupancies: 250 gpm.

D. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13. The seismic design criteria are listed on the Structural drawings.

E. Comply with requirements of NFPA 13.

1.6 SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

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

1. Include manufacturer's catalog cut. Each submittal shall indicate the name of the manufacturer with data highlighted to indicate model, size, rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

C. Shop Drawings: For wet-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

D. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

E. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Domestic water piping.
2. Compressed air piping.
3. HVAC hydronic piping.
4. Gas piping.
5. Industrial equipment.
6. Items penetrating finished ceiling include the following:

a. Lighting fixtures.
b. Air outlets and inlets.

F. Qualification Data: For qualified Installer and professional engineer.

G. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations.

H. Welding certificates.

I. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."

J. Field quality-control reports.

K. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility.

a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

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

C. 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.

D. Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13, "Installation of Sprinkler Systems."

1.8 COORDINATION

A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

1.9 SPARE PARTS

A. Furnish Spare Parts that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

2.2 STEEL PIPE AND FITTINGS

A. Standard Weight, Galvanized and Black-Steel Pipe: ASTM A 53, Type E. Pipe ends may be factory or field formed to match joining method.

B. Galvanized and Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53, standard-weight, seamless steel pipe with threaded ends.

C. Galvanized and Uncoated, Steel Couplings: ASTM A 865, threaded.

D. Galvanized and Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

E. Malleable- or Ductile-Iron Unions: UL 860.

F. Cast-Iron Flanges: ASME 16.1, Class 125.

G. Grooved-Joint, Steel-Pipe Appurtenances:

1. Manufacturers: Subject to compliance with requirements available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Anvil International, Inc.
b. Corcoran Piping System Co.
c. National Fittings, Inc.

d. Tyco Fire & Building Products LP.
e. Victaulic Company.
f. Or approved equal.

2. Pressure Rating: 175 psig minimum.
3. Galvanized and Uncoated, Grooved-End Fittings for Steel Piping: ASTM A47, malleable-iron casting or ASTM A536, ductile-iron casting; with dimensions matching steel pipe.
4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.
5. Grooved-End-Tube Couplings: To fit copper-tube dimensions, with design similar to AWWA C606. Include ferrous housing sections, EPDM-rubber gasket suitable for hot and cold water, and bolts and nuts.

2.3 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic and asbestos free.

1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 LISTED FIRE-PROTECTION VALVES

A. General Requirements:

1. Valves shall be UL listed or FM approved.
2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig.

B. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Anvil International, Inc.
b. Victaulic Company.
c. Or approved equal.

2. Standard: UL 1091 except with ball instead of disc.
3. Valves NPS 1-1/2 and Smaller: Bronze body with threaded ends.

C. Iron Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Anvil International, Inc.
    b. Fivalco Inc.
    c. Global Safety Products, Inc.
    d. Kennedy Valve; a division of McWane, Inc.
    e. Milwaukee Valve Company.
    f. NIBCO INC.
    g. Pratt, Henry Company.
    h. Tyco Fire & Building Products LP.
    i. Victaulic Company.
    j. Or approved equal

2. Standard: UL 1091.
3. Pressure Rating: 175 psig.
4. Body Material: Cast or ductile iron.
5. Style: Lug or wafer.
6. End Connections: Grooved.

D. Check Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    a. Crane Co.; Crane Valve Group.
    b. Kennedy Valve; a division of McWane, Inc.
    c. Milwaukee Valve Company.
    d. Mueller Co.; Water Products Division.
    e. Potter Roemer.
    f. Reliable Automatic Sprinkler Co., Inc.
    g. Tyco Fire & Building Products LP.
    h. Victaulic Company.
    i. Viking Corporation.
    j. Or approved equal.

2. Standard: UL 312.
3. Pressure Rating: 250 psig.
4. Type: Swing check.
5. Body Material: Cast iron.
6. End Connections: Flanged or grooved.

E. Bronze OS&Y Gate Valves (2 inch and smaller):

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Crane Co.; Crane Valve Group.

b. Milwaukee Valve Company.
c. NIBCO INC.
d. United Brass Works, Inc.
e. Or approved equal.

2. Standard: UL 262.
3. Pressure Rating: 175 psig.
4. Body Material: Bronze.
5. End Connections: Threaded.

F. Iron OS&Y Gate Valves (2-1/2 inch and larger):

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
b. American Valve, Inc.
c. Clow Valve Company; a division of McWane, Inc.
d. Crane Co.; Crane Valve Group.
e. Hammond Valve.
f. Milwaukee Valve Company.
g. Mueller Co.; Water Products Division.
h. NIBCO INC.
i. Tyco Fire & Building Products LP.
j. United Brass Works, Inc.
k. Watts Water Technologies, Inc.
l. Or approved equal.

2. Standard: UL 262.
3. Pressure Rating: 250 psig.
4. Body Material: Cast or ductile iron.
5. End Connections: Flanged or grooved.

2.5 SPECIALTY VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating:

a. Standard-Pressure Piping Specialty Valves: 175 psig.

3. Body Material: Cast or ductile iron.
4. Size: Same as connected piping.
5. End Connections: Flanged or grooved.

B. Alarm Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. AFAC Inc.
    b. Globe Fire Sprinkler Corporation.
    c. Reliable Automatic Sprinkler Co., Inc.
    d. Tyco Fire & Building Products LP.
    e. Venus Fire Protection Ltd.
    f. Victaulic Company.
    g. Viking Corporation.
    h. Or approved equal.

2. Standard: UL 193.
3. Design: For horizontal or vertical installation.
4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, retarding chamber**,** and fill-line attachment with strainer.
5. Drip Cup Assembly: Pipe drain with check valve to main drain piping.

C. Automatic (Ball Drip) Drain Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. AFAC Inc.
    b. Reliable Automatic Sprinkler Co., Inc.
    c. Tyco Fire & Building Products LP.
    d. Or approved equal.

2. Standard: UL 1726.
3. Pressure Rating: 175 psig.
4. Type: Automatic draining, ball check.
5. Size: NPS 3/4.
6. End Connections: Threaded.

2.6 FIRE-DEPARTMENT CONNECTIONS

A. Fire-Department Connection:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. AFAC Inc.
    b. Elkhart Brass Mfg. Company, Inc.
    c. Fire-End & Croker Corporation.
    d. Fire Protection Products, Inc.
    e. GMR International Equipment Corporation.
    f. Guardian Fire Equipment, Inc.

g. Tyco Fire & Building Products LP.
h. Wilson & Cousins Inc.
i. Or approved equal.

2. Standard: UL 405.
3. Type: Exposed, projecting, for wall mounting.
4. Pressure Rating: 175 psig.
5. Body Material: Corrosion-resistant metal.
6. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
7. Caps: Brass, lugged type, with gasket and chain.
8. Escutcheon Plate: Round, brass, wall type.
9. Outlet: With pipe threads.
10. Number of Inlets: Three.
11. Outlet Location: Back.
12. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE."
13. Finish: Polished chrome plated.
14. Outlet Size: NPS 6.

2.7 SPRINKLER SPECIALTY PIPE FITTINGS

A. Branch Outlet Fittings:

1. Manufacturers: Subject to compliance with requirements: available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Anvil International, Inc.
b. National Fittings, Inc.
c. Shurjoint Piping Products.
d. Tyco Fire & Building Products LP.
e. Victaulic Company.
f. Or approved equal.

2. Standard: UL 213.
3. Pressure Rating: 175 psig .
4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
5. Type: Mechanical-T and -cross fittings.
6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
8. Branch Outlets: Grooved, plain-end pipe, or threaded.

B. Flow Detection and Test Assemblies:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. AGF Manufacturing Inc.
b. Reliable Automatic Sprinkler Co., Inc.
c. Tyco Fire & Building Products LP.
d. Victaulic Company
e. Or approved equal.

2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Pressure Rating: 175 psig.
4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

C. Branch Line Testers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Elkhart Brass Mfg. Company, Inc.
b. Fire-End & Croker Corporation.
c. Potter Roemer.
d. Or approved equal.

2. Standard: UL 199.
3. Pressure Rating: 175 psig.
4. Body Material: Brass.
5. Size: Same as connected piping.
6. Inlet: Threaded.
7. Drain Outlet: Threaded and capped.
8. Branch Outlet: Threaded, for sprinkler.

D. Sprinkler Inspector's Test Fittings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. AGF Manufacturing Inc.
b. Triple R Specialty.
c. Tyco Fire & Building Products LP.
d. Victaulic Company.
e. Viking Corporation.
f. Or approved equal.

2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Pressure Rating: 175 psig.
4. Body Material: Cast- or ductile-iron housing with sight glass.
5. Size: Same as connected piping.

6. Inlet and Outlet: Threaded.

E. Adjustable Drop Nipples:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. CECA, LLC.
b. Corcoran Piping System Co.
c. Merit Manufacturing; a division of Anvil International, Inc.
d. Or approved equal.

2. Standard: UL 1474.
3. Pressure Rating: 250 psig.
4. Body Material: Steel pipe with EPDM-rubber O-ring seals.
5. Size: Same as connected piping.
6. Length: Adjustable.
7. Inlet and Outlet: Threaded.

2.8 SPRINKLERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AFAC Inc.
2. Globe Fire Sprinkler Corporation.
3. Reliable Automatic Sprinkler Co., Inc.
4. Tyco Fire & Building Products LP.
5. Venus Fire Protection Ltd.
6. Victaulic Company.
7. Viking Corporation.
8. Or approved equal.

B. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating for Automatic Sprinklers: 175 psig.

C. Automatic Sprinklers with Heat-Responsive Element:

1. Early-Suppression, Fast-Response Applications: UL 1767.
2. Nonresidential Applications: UL 199.
3. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6 and "Ordinary" temperature classification rating.

D. Sprinkler Finishes:

1. Rough brass.

E. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

1. Ceiling Mounting: Natural brass, one piece, flat
2. Sidewall Mounting: Natural brass**,** one piece, flat.

2.9 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Electrically Operated Alarm Bell:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Fire-Lite Alarms, Inc.; a Honeywell company.
   b. Notifier; a Honeywell company.
   c. Potter Electric Signal Company.
   d. Or approved equal.

2. Standard: UL 464.
3. Type: Vibrating, metal alarm bell.
4. Size: 10-inch diameter.
5. Finish: Red-enamel factory finish, suitable for outdoor use.

C. Pressure Switches:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. AFAC Inc.
   b. Barksdale, Inc.
   c. Detroit Switch, Inc.
   d. Potter Electric Signal Company.
   e. System Sensor; a Honeywell company.
   f. Tyco Fire & Building Products LP.
   g. United Electric Controls Co.
   h. Viking Corporation.
   i. Or approved equal.

2. Standard: UL 346.
3. Type: Electrically supervised water-flow switch with retard feature.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design Operation: Rising pressure signals water flow.

D. Valve Supervisory Switches:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Fire-Lite Alarms, Inc.; a Honeywell company.
    b. Kennedy Valve; a division of McWane, Inc.
    c. Potter Electric Signal Company.
    d. System Sensor; a Honeywell company.
    e. Or approved equal.

2. Standard: UL 346.
3. Type: Electrically supervised.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design: Signals that controlled valve is in other than fully open position.

2.10 PRESSURE GAGES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AMETEK; U.S. Gauge Division.
2. Ashcroft, Inc.
3. Brecco Corporation.
4. WIKA Instrument Corporation.
5. Or approved equal.

B. Standard: UL 393.

C. Dial Size: 3-1/2- to 4-1/2-inch diameter.

D. Pressure Gage Range: 0 to 250 psig.

E. Water System Piping Gage: Include "WATER" label on dial face.

2.11 ESCUTCHEONS

A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.

B. One-Piece, Cast-Brass Escutcheons: Polished chrome-plated finish with set-screws.

C. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

2.12 SLEEVES

A. Cast-Iron Wall Pipe Sleeves: Cast or fabricated of cast iron and equivalent to ductile-iron pressure pipe, with plain ends.

B. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, standard weight, zinc coated, plain ends.

2.13 SLEEVE SEALS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Advance Products & Systems, Inc.
2. Calpico, Inc.
3. Metraflex, Inc.
4. Pipeline Seal and Insulator, Inc.
5. Or approved equal.

B. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe.
2. Pressure Plates: Carbon steel.
3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements.

2.14 GROUT

A. Standard: ASTM C 1107, Grade B, posthardening and volume adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink, and recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.

B. Report test results promptly and in writing.

3.2 SERVICE-ENTRANCE PIPING

A. Connect sprinkler piping to water-service piping for service entrance to building. Comply with requirements for exterior piping in Division 21 Section "Facility Fire-Suppression Water-Service Piping."

B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping. Comply with requirements for backflow preventers in Division 21 Section 21 11 00 "Facility Fire-Suppression Water-Service Piping."

C. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

3.3 WATER-SUPPLY CONNECTIONS

A. Install the valve header, the shutoff valves, pressure gage, drain, and other accessories.

B. Connect the fire pump to the valve header, install the alarm check valves and their appurtenances.

C. Install distribution piping and connect to the corresponding zone valve.

3.4 PIPING INSTALLATION

A. Locations and Arrangements: Contract drawing plans and schematics indicate general location and arrangement of piping. Install piping as indicated in the Sprinkler Contractor's construction drawings.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Engineer before deviating from approved working plans.

B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.

C. Install seismic restraints on piping. Comply with requirements for seismic-restraint device materials and installation in NFPA 13 and design criteria indicated on the Structural drawings.

D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

E. Install unions adjacent to each valve in pipes NPS 2 and smaller.

F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

H. Install sprinkler piping with drains for complete system drainage.

I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

J. Install automatic (ball drip) drain valve at the check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain.

K. Install alarm devices in piping systems.

L. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.

M. Install pressure gages on riser or feed main, at each sprinkler test connection. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.

N. Fill sprinkler system piping with water.

3.5 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

D. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

F. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.

1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

G. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

H. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

I. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

J. Provide and install expansion fittings in all piping crossing the building expansion and seismic joints (see specification Section 22 05 16).

3.6 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Specialty Valves:

1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
2. Alarm Valves: Include bypass check valve and retarding chamber drain-line connection.

3.7 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.

3.8 FIRE-DEPARTMENT CONNECTION INSTALLATION

A. Install wall-type, fire-department connections.

B. Install automatic (ball drip) drain valve at each check valve for fire-department connection.

3.9 ESCUTCHEON INSTALLATION

A. Install escutcheons for penetrations of walls, ceilings, and floors.

B. Escutcheons for New Piping:

1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
2. Bare Piping at Wall in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
3. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
4. Bare Piping in Unfinished Service Spaces: One piece, cast brass with polished chrome-plated finish.
5. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.

3.10 SLEEVE INSTALLATION

A. General Requirements: Install sleeves for pipes passing through penetrations in floors, partitions, roofs, and walls.

B. Sleeves are not required for core-drilled holes.

C. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.

D. Install sleeves in partitions, slabs, and walls as they are built.

E. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 07 Section "Joint Sealants."

F. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 07 Section "Joint Sealants."

G. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using sleeve seals.

H. Seal space outside of sleeves in concrete slabs and walls with grout.

I. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.

J. Install sleeve materials according to the following applications:

1. Sleeves for Piping Passing through Concrete Floor Slabs: Galvanized-steel pipe.

    a. Extend sleeves 2 inches above finished floor level.

2. Sleeves for Piping Passing through Gypsum-Board Partitions:
    a. Galvanized-steel-pipe.

3. Sleeves for Piping Passing through Interior Concrete Walls:
    a. Galvanized-steel-pipe.

K. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestop materials and installations in Division 07 Section "Firestopping."

3.11 SLEEVE SEAL INSTALLATION

A. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.12 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section 26 05 53 "Identification for Electrical Systems."

3.13 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
4. Energize circuits to electrical equipment and devices.
5. Start and run excess-pressure pumps.
6. Coordinate with fire-alarm tests. Operate as required.
7. Coordinate with fire-pump tests. Operate as required.
8. Verify that equipment hose threads are same as local fire-department equipment.

C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.14 CLEANING

A. Clean dirt and debris from sprinklers.

B. Remove and replace sprinklers with paint other than factory finish.

3.15 PIPING SCHEDULE

A. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with grooved ends, grooved-end fittings, grooved-end-pipe couplings and grooved joints.

B. Sprinkler specialty fittings may be used, downstream of control vales, instead of specified fittings.

C. Standard-pressure, wet-pipe sprinkler system, NPS 2 and smaller shall be the following:

1. Standard-weight black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.

D. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 to NPS 4 shall be the following:

1. Standard-weight black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
2. Standard-weight black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

E. Standard-pressure, wet-pipe sprinkler system, NPS 5 and larger shall be the following:

1. Standard-weight black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
2. Standard-weight, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

3.16 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:

1. Rooms without Ceilings: Upright sprinklers.
2. Rooms with Suspended Ceilings: Concealed sprinklers.
3. Wall Mounting: Sidewall sprinklers.

END OF SECTION 21 13 13

SECTION 21 13 16 - DRY-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 DESIGN:

A. Provide, install and test a dry-pipe sprinkler system and preaction systems with all appurtenances, in areas indicated in drawings F5-111 and F5-112.

1.2 SUMMARY

A. Section Includes:

1. Pipes, fittings, and specialties.
2. Fire-protection valves.
3. Sprinkler specialty pipe fittings.
4. Sprinklers.
5. Alarm devices.
6. Pressure gages.

B. Related Sections:

1. Division 21 Section 21 12 00 "Fire-Suppression Standpipes" for standpipe piping.
2. Division 21 Section 21 13 13 "Wet-Pipe Sprinkler Systems" for wet-pipe sprinkler piping.
3. Division 21 Section 21 31 13 "Electric-Drive, Centrifugal Fire Pumps" for fire pump, pressure-maintenance pump, and fire-pump controller.
4. Division 28 Section 28 31 11 “Digital Addressable Fire-Alarm System” for alarm devices not specified in this Section.

1.3 SYSTEM DESCRIPTIONS

A. Dry-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing compressed air. Opening of sprinklers releases compressed air and permits water pressure to open dry-pipe valve. Water then flows into piping and discharges from sprinklers that are open.

B. Preaction Sprinkler System: Actuation of a fire-detection system, in the same area as sprinklers, opens the deluge valve permitting water to flow into the sprinkler piping; then water will discharge from sprinklers that have opened.

1.4 PERFORMANCE REQUIREMENTS

A. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

B. Delegated Design: Design sprinkler system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1. Estimated discharge pressure at the fire pump is 80 psi.

C. Sprinkler system design shall be approved by authorities having jurisdiction.

1. Margin of Safety for Available Water Flow and Pressure: losses through water-service piping, are included, also included fittings, and backflow preventers.
2. Sprinkler Occupancy Hazard Classifications:

a. Service and Inspection Area: Ordinary Hazard, Group 2.
b. Electrical Equipment Rooms: Ordinary Hazard, Group 1.

3. Minimum Density for Dry Systems Design:

a. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1,950-sq. ft.
b. Ordinary-Hazard, Group 2 Occupancy: 0.19 gpm over 2,600-sq. ft.

4. Maximum Protection Area per Sprinkler: Per UL listing.
5. Maximum Protection Area per Sprinkler: 130 sq. ft.

6. Total Combined Hose-Stream Demand Requirement: According to NFPA 13:

a. Ordinary-Hazard Occupancies: 250 gpm.

D. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13 and criteria listed on Structural drawings.

E. Comply with the requirements of NFPA 13.

1.5 SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR - SUBMITTALS.

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

1. Include manufacturer's catalog cut. Each submittal shall indicate the name of the manufacturer with data highlighted to indicate model, size, rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

C. Shop Drawings: For dry-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

D. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

E. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Domestic water piping.
2. Compressed air piping.
3. HVAC hydronic piping.
4. Gas piping.
5. Industrial equipment.
6. Items penetrating finished ceiling include the following:

a. Lighting fixtures.
b. Air outlets and inlets.

F. Qualification Data: For qualified Installer and professional engineer registered in the State of Connecticut.

G. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations.

H. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."

I. Field quality-control reports.

J. Operation and maintenance data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer registered in the State of Connecticut.

B. 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.

C. Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13, "Installation of Sprinkler Systems."

1.7 `WARRANTY

A. Refer to Form 816 Article 1.20-1.06.08 and NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Refer to Form 816 Article 1.06.03 and Form 816 Article 1.20-1.06.03 for additional information.

1.9 SPARE PARTS

A. Furnish Spare Parts that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

PART 2 - PRODUCT

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 STEEL PIPE AND FITTINGS

A. Standard Weight, Galvanized-Steel Pipe: ASTM A 53, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.

B. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53, standard-weight, seamless steel pipe with threaded ends.

C. Galvanized, Steel Couplings: ASTM A 865, threaded.

D. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

E. Grooved-Joint, Steel-Pipe Appurtenances:

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

a. Anvil International, Inc.
b. Corcoran Piping System Co.
c. National Fittings, Inc.

d. Shurjoint Piping Products.
e. Tyco Fire & Building Products LP.
f. Victaulic Company.
g. Or approved equal

2. Pressure Rating: 175 psig minimum.
3. Galvanized, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.3 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic and asbestos free.

1. Class 125, Cast-Iron Flat-Face Flanges: Full-face gaskets.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

2.4 LISTED FIRE-PROTECTION VALVES

A. General Requirements:

1. Valves shall be UL listed or FM approved.
2. Minimum Pressure Rating: 175 psig.

B. Check Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers :
   a. Clow Valve Company; a division of McWane, Inc.
   b. Crane Co.; Crane Valve Group.
   c. Fire-End & Croker Corporation.
   d. Fire Protection Products, Inc.
   e. Globe Fire Sprinkler Corporation.
   f. Kennedy Valve; a division of McWane, Inc.
   g. Milwaukee Valve Company.
   h. Mueller Co.; Water Products Division.
   i. Potter Roemer.
   j. Reliable Automatic Sprinkler Co., Inc.
   k. Tyco Fire & Building Products LP.
   l. Victaulic Company.
   m. Or approved equal

2. Standard: UL 312
3. Pressure Rating: 250 psig.
4. Type: Swing check.
5. Body Material: Cast iron.

6. End Connections: Flanged or grooved.

C. Iron OS&Y Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
   a. Crane Co.; Crane Valve Group;
   b. Milwaukee Valve Company.
   c. Mueller Co.; Water Products Division.
   d. Tyco Fire & Building Products LP.
   e. Or approved equal.

2. Standard: UL 262.
3. Pressure Rating: 250 psig.
4. Body Material: Cast or ductile iron.
5. End Connections: Flanged or grooved.

2.5 TRIM AND DRAIN VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Minimum Pressure Rating: 175 psig.

B. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
   a. Conbraco Industries, Inc.; Apollo Valves.
   b. Fire-End & Croker Corporation.
   c. Fire Protection Products, Inc.
   d. Kennedy Valve; a division of McWane, Inc.
   e. Metso Automation USA Inc.
   f. Milwaukee Valve Company.
   g. NIBCO INC.
   h. Potter Roemer.
   i. Tyco Fire & Building Products LP.
   j. Victaulic Company.
   k. Or approved equal

2.6 SPECIALTY VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Minimum Pressure Rating: 175 psig.
3. Body Material: Cast or ductile iron.

4. Size: Same as connected piping.
5. End Connections: Flanged or grooved.

B. Dry-Pipe Valves:

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

    a. Globe Fire Sprinkler Corporation.
    b. Reliable Automatic Sprinkler Co., Inc.
    c. Tyco Fire & Building Products LP.
    d. Victaulic Company.
    e. Viking Corporation.
    f. Or approved equal

2. Standard: UL 260
3. Design: Differential-pressure type.
4. Include UL 1486, quick-opening devices, trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
5. Quick Response Device for the DPV valves: Include anti-flooding device.
6. Air Compressor:

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

        1) Gast Manufacturing Inc.
        2) General Air Products, Inc,
        3) Viking Corporation.
        4) Or approved equal

    b. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
    c. Motor Horsepower: Fractional.
    d. Power: 120-V ac, 60 Hz, single phase.

7. Pressure Maintenance Device

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

        1) AFAC Inc.
        2) Globe Fire Sprinkler Corporation.
        3) Reliable Automatic Sprinkler Co., Inc.
        4) Tyco Fire & Building Products LP.
        5) Venus Fire Protection Ltd.
        6) Victaulic Company.
        7) Viking Corporation.

8) Or approved equal

b. Standard: UL 260
c. Type: Automatic device to maintain minimum air pressure in piping.
d. Include shutoff valves to permit servicing without shutting down sprinkler piping, bypass valve for quick filling, pressure regulator or switch to maintain pressure, strainer, pressure ratings with 14- to 60-psig adjustable range, and 175-psig outlet pressure.

C. Preaction Valves:

1. Manufacturers: Subject to compliance with requirements, provide product by one of the following:
   a. CLA-VAL Automatic Control Valves.
   b. Globe Fire Sprinkler Corporation.
   c. Reliable Automatic Sprinkler Co., Inc.
   d. Tyco Fire & Building Products LP.
   e. Victaulic Company.
   f. Viking Corporation.
   g. Or approved equal

2. Standard: UL 260.
3. Design: Hydraulically operated, differential-pressure type.
4. Include trim sets for electrical actuation, include control release panel, pressure switch, drain, pressure gauges, drip cup.

2.6 CONTROL PANELS

1. Description: Single-area, control panel including NEMA ICS 6, Type 1 enclosure, alarm, and solenoid-valve circuitry for operation of deluge valves. Panels contain detector power supply; battery charger; standby batteries; field-wiring terminal strip; electrically supervised solenoid valves and polarized fire-alarm bell; lamp test facility; single-pole, double-throw auxiliary alarm contacts; and rectifier.

2. Panels: UL listed and FM approved when used with thermal detectors and Class A wiring. Electrical characteristics are 120-V ac, 60 Hz, with 24-V dc rechargeable batteries.

3. Manual Control Stations: Electric operation, metal enclosure, labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.

2.7 SPRINKLER SPECIALTY PIPE FITTINGS

A. General Requirements for Dry-Pipe-System Fittings: UL listed for dry-pipe service.

B. Branch Outlet Fittings:

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

    a. Anvil International, Inc.
    b. National Fittings, Inc.
    c. Shurjoint Piping Products.
    d. Tyco Fire & Building Products LP.
    e. Victaulic Company.
    f. Or approved equal.

2. Standard: UL 213.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
5. Type: Mechanical-T and -cross fittings.
6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
8. Branch Outlets: Grooved, plain-end pipe, or threaded.

C. Branch Line Testers:

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

    a. Elkhart Brass Mfg. Company, Inc.
    b. Fire-End & Croker Corporation.
    c. Potter Roemer.
    d. Or approved equal.

2. Standard: UL 199.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Brass.
5. Size: Same as connected piping.
6. Inlet: Threaded.
7. Drain Outlet: Threaded and capped.
8. Branch Outlet: Threaded, for sprinkler.

D. Sprinkler Inspector's Test Fittings:

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

    a. AGF Manufacturing Inc.
    b. Triple R Specialty.
    c. Tyco Fire & Building Products LP.
    d. Victaulic Company.
    e. Viking Corporation.
    f. Or approved equal.

2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Cast- or ductile-iron housing with sight glass.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

2.8 SPRINKLERS

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

1. AFAC Inc.
2. Globe Fire Sprinkler Corporation.
3. Reliable Automatic Sprinkler Co., Inc.
4. Tyco Fire & Building Products LP.
5. Venus Fire Protection Ltd.
6. Victaulic Company.
7. Viking Corporation.
8. Or approved equal.

B. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating for Automatic Sprinklers: 175 psig minimum.
3. Pressure Rating for High-Pressure Automatic Sprinklers: 250 psig minimum.

C. Automatic Sprinklers with Heat-Responsive Element:

1. Nonresidential Applications: UL 199 upright.

2. Dry pipe sprinklers: UL 199, sidewall.

3. Characteristics: Nominal 1/2-inch orifice with discharge coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application. . Sprinkler heads installed in the preaction system shall be of “Intermediate” temperature classification rating.

D. Sprinkler Finishes:
1. Rough bronze.
2. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

2.9 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Valve Supervisory Switches:

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

a. Fire-Lite Alarms; a Honeywell company.
b. Kennedy Valve; a division of McWane, Inc.
c. Potter Electric Signal Company.
d. System Sensor; a Honeywell company.
e. Or approved equal

2. Standard: UL 346.
3. Type: Electrically supervised.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design: Signals that controlled valve is in other than fully open position.

2.10 PRESSURE GAGES

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

1. AMETEK, Inc.; U.S. Gauge Division.
2. Ashcroft, Inc.
3. Brecco Corporation.
4. WIKA Instrument Corporation.
5. Or approved equal

B. Standard: UL 393.

C. Dial Size: 3-1/2- to 4-1/2-inch diameter.

D. Pressure Gage Range: 0 to 250 psig minimum.

E. Water System Piping Gage: Include "WATER" label on dial face.

F. Air System Piping Gage: Include "AIR" label on dial face.

2.11 ESCUTCHEONS

A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.

B. One-Piece, Cast-Brass Escutcheons: Polished chrome-plated finish with set-screws.

2.12 SLEEVES

A. Cast-Iron Wall Pipe Sleeves: Cast or fabricated of cast iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Galvanized-Steel-Pipe Sleeves: ASTM A 53, Type E, standard weight, zinc coated, plain ends.

2.13 SLEEVE SEALS

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

1. Advance Products & Systems, Inc.
2. Calpico, Inc.
3. Metraflex, Inc.
4. Pipeline Seal and Insulator, Inc.
5. Or approved equal

B. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Sealing Elements: NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Carbon steel.
3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements.

2.14 GROUT

A. Standard: ASTM C 1107, Grade B, posthardening and volume adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink, and recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.

3.2 WATER-SUPPLY CONNECTIONS

A. Install shutoff valve, the dry-pipe valves, the preaction valves and all the accessories, and connect to the fire water header.

B. Install the air compressor, the air maintenance devices, the air gauges and connect to the dry-pipe valves.

3.3 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Designer before deviating from approved working plans.

B. Piping Standard: Comply with requirements in NFPA 13 for installation of sprinkler piping.

C. Install seismic restraints on piping. Comply with requirements in NFPA 13 for seismic-restraint device materials and installation as well as details as shown on Structural drawings.

D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

E. Install unions adjacent to each valve in pipes NPS 2 and smaller.

F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

H. Install sprinkler piping with drains for complete system drainage.

I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

J. Install alarm devices in piping systems.

K. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements in NFPA 13 for hanger materials.

L. Drain dry-pipe sprinkler piping.

M. Pressurize and check dry-pipe sprinkler system piping and air compressors.

3.4 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

D. Ream ends of pipes and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

H. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

I. Provide and install expansion fittings in all piping crossing the building expansion and seismic joints (see specification Section 22 05 16).

3.5 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection.

D. Specialty Valves:

1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
2. Dry-Pipe and Preaction Valves: Install trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.

    a. Install air compressor, pressure maintenance device and compressed-air supply piping.

3.6 ESCUTCHEON INSTALLATION

A. Install escutcheons for penetrations of walls, ceilings, and floors.

1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
2. Bare Piping in Unfinished Service Spaces: One piece, stamped steel with set-screw or spring clips.

3.7 SLEEVE INSTALLATION

A. General Requirements: Install sleeves for pipes passing through penetrations in floors, partitions, roofs, and walls.

B. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.

C. Install sleeves in new partitions, slabs, and walls as they are built.

D. For interior wall penetrations, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 07 Section 07 92 00 "Joint Sealants".

E. Seal space outside of sleeves in concrete slabs and walls with grout.

F. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe unless otherwise indicated.

G. Install sleeve materials according to the following applications:

1. Sleeves for Piping Passing through Concrete Floor Slabs: Galvanized-steel pipe.

2. Sleeves for Piping Passing through Gypsum-Board Partitions:

   a. Galvanized-steel-pipe sleeves.

3. Sleeves for Piping Passing through Interior Concrete Walls:

   a. Galvanized-steel pipe sleeves.

H. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 07 Section 07 84 00 "Firestopping" for firestop materials and installations.

3.8 SLEEVE SEAL INSTALLATION

A. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.

B. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand.

3.9 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section 26 05 53 "Identification for Electrical Systems."

3.10 FIELD QUALITY CONTROL

A. Perform tests and inspections in accordance with Form 816 Article 1.20-1.05.10 and as follows:

B. Tests and Inspections:

1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
4. Energize circuits to electrical equipment and devices.
5. Start and run air compressors.
6. Coordinate with fire-alarm tests. Operate as required.
7. Coordinate with fire-pump tests. Operate as required.
8. Verify that equipment hose threads are same as local fire-department equipment.

C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.11 CLEANING

A. Clean dirt and debris from sprinklers.

B. Remove and replace sprinklers with paint other than factory finish.

3.12 PIPING SCHEDULE

A. Sprinkler specialty fittings may be used, downstream of control vales, instead of specified fittings.

B. Dry-pipe sprinkler system shall be the following:

1. Standard-weight, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.

2. Standard-weight, galvanized-steel pipe with cut-grooved ends; galvanized, grooved end fittings for steel piping, grooved end pipe couplings and grooved joints.

END OF SECTION 21 13 16

SECTION 22 13 19 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following sanitary drainage piping specialties:

1. Cleanouts.
2. Floor drains.
3. Gutter drains.
4. Miscellaneous sanitary drainage and industrial waste piping specialties.

1.2 SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Shop Drawings: Show fabrication and installation details for frost-resistant vent terminals.

1. Wiring Diagrams: Power, signal, and control wiring.

C. Product Data: For each type of product indicated include catalog data, drawings, rated capacities, operating characteristics, and accessories.

D. Manufacturer Seismic Qualification Certification: Submit certification that accessories, and components will withstand seismic forces defined in Division 22 Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment." Include the following, as well as specification (criteria) listed in the Structural plans:

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."

2. Dimensioned Outline Plans 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.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.3 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

1.4 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.

B. Coordinate size and location of roof penetrations.

1.5 WARRANTY

A. Refer to Form 816 Article 1.20-1.06.08 and NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Refer to Form 816 Article 1.06.03 and Form 816 Article 1.20-1.06.03 for additional information.

PART 2 - PRODUCTS

2.1 CLEANOUTS

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

      a. Josam Company; Josam Div.
      b. Oatey.
      c. Sioux Chief Manufacturing Company, Inc.
      d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
      e. Tyler Pipe; Wade Div.
      f. Watts Drainage Products Inc.
      g. Zurn Plumbing Products Group; Light Commercial Operation.
      h. Zurn Plumbing Products Group; Specification Drainage Operation.
      i. Kusel Equipment Co.
      j. Or approved equal.

   2. Standard: ASME A112.36.2M for heavy-duty, adjustable housing cleanout.
   3. Size: Same as connected branch.
   4. Type: Heavy-duty.
   5. Body or Ferrule: Cast iron.
   6. Clamping Device: Required.
   7. Outlet Connection: Threaded.

8. Adjustable Housing Material: Cast iron with threads.
9. Frame and Cover Material and Finish: Cast iron heavy duty secured in areas marked as 1, 2A, 2B in the architecture finished floor drawings, ceramic tiles in the areas marked as 4, and carpet in areas marked as 8. Refer to drawings A1-611, A1-612, A1-613 and A1-614.
10. Frame and Cover Shape: Round.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains:

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

    a. Commercial Enameling Co.
    b. Josam Company; Josam Div.
    c. MIFAB, Inc.
    d. Prier Products, Inc.
    e. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    f. Tyler Pipe; Wade Div.
    g. Watts Drainage Products Inc.
    h. Zurn Plumbing Products Group; Light Commercial Operation.
    i. Zurn Plumbing Products Group; Specification Drainage Operation.
    j. Or approved equal.

2. Standard: ASME A112.6.3.
3. Pattern: Floor drain, Funnel, as indicated.
4. Body Material: Cast iron.
5. Outlet: Bottom.
6. Top or Strainer Material: Cast iron.
7. Top of Strainer Finish: Cast iron.
8. Top Shape: Round.
9. Top Loading Classification: Heavy Duty.
10. Trap Material: Cast Iron.
11. Trap Pattern: Standard P-trap.
12. Inlet Fitting: Trap primer connection.

B. Floor Drains with Sediment Buckets:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Josam Company.
    b. MIFAB, Inc.
    c. Zurn Plumbing Products Group
    d. Or approved equal.
2. Requirements: Must meet the requirements listed in Part A.
3. Removable Sediment Bucket: Must include a removable sediment bucket to collect metallic debris which may clog the waste line.

2.3 GUTTER DRAINS

A. Gutter Drains:

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

a. Josam Company; Josam Div.
b. MIFAB, Inc.
c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
d. Tyler Pipe; Wade Div.
e. Watts Drainage Products Inc.
f. Zurn Plumbing Products Group; Specification Drainage Operation.
g. Or approved equal.

2. Standard: ASME A112.6.3.
3. Material: Cast iron.
4. Outlet: Bottom.
5. Grate Material: Cast iron or nickel bronze.
6. Top Loading Classification: Heavy Duty.
7. Size: 4” x 12”.

2.4 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Floor-Drain, Trap-Seal Primer Fittings:

1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
2. Size: Same as floor drain outlet with NPS 1/2 side inlet.

B. Vent Caps:

1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
2. Size: Same as connected stack vent or vent stack.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 22 Section 22 05 00 "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4.
2. Locate at each change in direction of piping greater than 45 degrees.

3. Locate at minimum intervals of 50 feet for piping.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:

a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.

3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

E. Install flashing fittings on sanitary vents that extend through roof.

F. Install deep-seal traps on floor drains.

G. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.

1. Exception: Fitting may be omitted if trap has trap-seal primer connection.

H. Install vent caps on each vent pipe passing through roof.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Plans indicate general arrangement of piping, fittings, and specialties.

3.3 LABELING AND IDENTIFYING

A. Nameplates and signs are specified in Division 22 Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports in accordance with Form 816 Article 1.20-1.05.10 and as follows:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

3.5 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

3.6 DEMONSTRATION

A. Refer to Form 816 Article 1.20-1.08.14 subsection 3 for additional information.

B. Engage a factory-authorized service representative to train Department's maintenance personnel to adjust, operate, and maintain.

END OF SECTION 22 13 19

SECTION 22 14 13 - FACILITY STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following storm drainage piping on the exterior of the building:

1. Pipe, tube, and fittings.
2. Special pipe fittings.
3. Underground metal piping (5 ft. outside the building).

1.2 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working-pressure, unless otherwise indicated:

1. Storm Drainage Piping: 10-foot head of water.

B. Seismic Performance: Storm drainage piping and support and installation shall be capable of withstanding the effects of seismic events determined according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures," as well as criteria listed on the structural drawings.

1.3 SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR - SUBMITTALS.

B. Product Data: For pipe, tube, fittings, and couplings.

C. Shop Drawings:

1. Design Calculations: Signed and sealed by a qualified professional engineer for selecting seismic restraints.

D. Field quality-control inspection and test reports.

1.4 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.2 HUB-AND-SPIGOT, CAST-IRON PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service.

B. Gaskets: ASTM C 564, rubber.

C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Storm drainage piping shall be:

1. Service class, cast-iron pipe and fittings; couplings, gaskets; and gasketed joints.

3.2 PIPING INSTALLATION

A. Basic piping installation requirements are specified in Division 22 Section 22 05 00 "Common Work Results for Plumbing."

B. Install seismic restraints on piping. Seismic-restraint devices are specified in Division 22 Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

C. Install flexible fittings in pipe crossing the building expansion and seismic joints.

D. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers. Cleanouts are specified in Division 22 Section 22 14 23 "Storm Drainage Piping Specialties."

E. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.3 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 22 Section 22 05 00 "Common Work Results for Plumbing."

B. Hub-and-Spigot, Cast-Iron Piping Gasketed Joints: Use rubber gaskets ASTM C564 and caulking material ASTM B29.

3.4 HANGER AND SUPPORT INSTALLATION

A. Seismic-restraint devices are specified in Division 22 Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment," and as shown on the structural drawings criteria.

B. Pipe hangers and supports are specified in Division 22 Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment." Install the following:

1. Vertical Piping: MSS Type 8 or Type 42, clamps.
2. Individual, Straight, Horizontal Piping Runs: According to the following:
    a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
3. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Install supports according to Division 22 Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

F. Install supports for vertical steel piping every 15 feet.

3.5 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect cast iron storm drainage piping to PVC storm drainage piping as indicated on the detail drawings.

C. Connect storm drainage piping to downspout boots as indicated on the detail drawings.

3.6 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Test Procedure: Test storm drainage piping**,** on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
5. Prepare reports for tests and required corrective action.
6. Insulate rain leaders per Section 22 07 00 “Plumbing Insulation”.

3.7 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 22 14 13

SECTION 22 14 23 - STORM DRAINAGE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following storm drainage piping specialties:

1. Cleanouts.

B. Related Sections include the following:

1. Division 22 Section 22 13 19 "Sanitary Waste Piping Specialties" for floor drains, trench drains and channel drainage systems connected to sanitary sewer, air admittance valves, FOG disposal systems, grease interceptors and removal devices, oil interceptors, and solid interceptors.

1.2 SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR - SUBMITTALS.

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

1.3 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

1.4 COORDINATION

A. Coordinate size and location of roof penetrations.

1.5 WARRANTY

A. Refer to Form 816 Article 1.20-1.06.08 and NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Refer to Form 816 Article 1.06.03 and Form 816 Article 1.20-1.06.03 for additional information.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Exposed Metal Cleanouts:

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

    a. Josam Company; Josam Div.
    b. MIFAB, Inc.
    c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    d. Tyler Pipe; Wade Div.
    e. Watts Drainage Products Inc.
    f. Zurn Plumbing Products Group; Specification Drainage Operation.
    g. Josam Company; Blucher-Josam Div.
    h. Or approved equal.

2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Size: Same as connected drainage piping
4. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch as required to match connected piping.
5. Closure: Countersunk, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Metal Floor Cleanouts:

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

    a. Josam Company; Josam Div.
    b. Oatey.
    c. Sioux Chief Manufacturing Company, Inc.
    d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    e. Tyler Pipe; Wade Div.
    f. Watts Drainage Products Inc.
    g. Zurn Plumbing Products Group; Light Commercial Operation.
    h. Zurn Plumbing Products Group; Specification Drainage Operation.
    i. Kusel Equipment Co.
    j. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    k. Josam Company; Blucher-Josam Div.
    l. Or approved equal

2. Standard: ASME A112.36.2M for cast-iron soil pipe with cast-iron ferrule cleanout.
3. Size: Same as connected branch.
4. Type: Cast-iron soil pipe with cast-iron ferrule
5. Body or Ferrule: Cast iron.
6. Clamping Device: Not required.
7. Outlet Connection: Inside calk.
8. Closure: Brass plug with straight threads and gasket.

9. Adjustable Housing Material: Cast iron with threads.
10. Frame and Cover Material and Finish: Nickel-bronze
11. Frame and Cover Shape: Round.
12. Top Loading Classification: Heavy Duty.
13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.
14. Standard: ASME A112.3.1.
15. Size: Same as connected branch.
16. Housing: Stainless steel.
17. Closure: Stainless steel with seal.
18. Riser: Stainless-steel drainage pipe fitting to cleanout.

C. Cast-Iron Wall Cleanouts:

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

    a. Josam Company; Josam Div.
    b. MIFAB, Inc.
    c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    d. Tyler Pipe; Wade Div.
    e. Watts Drainage Products Inc.
    f. Zurn Plumbing Products Group; Specification Drainage Operation.
    g. Or approved equal.

2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hub-and-spigot, cast-iron soil pipe T-branch as required to match connected piping.
5. Closure: Countersunk or raised-head plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, chrome-plated brass cover plate with screw.
8. Wall Access: Round wall-installation frame and cover.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 22 Section 22 05 00 "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install cleanouts in storm drainage piping on the exterior of the building in locations as indicated on the detail drawings.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

3.3 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 22 14 23

SECTION 22 15 13 - GENERAL-SERVICE COMPRESSED-AIR PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes piping and related specialties for general shop service, brake test, and valve test compressed-air systems operating at 250 psig or less.

B. Related Sections include the following:

1. Division 22 Section 22 15 19 "General-Service Packaged Air Compressors and Receivers" for general-service air compressors and accessories.

1.2 DEFINITIONS

A. CR: Chlorosulfonated polyethylene synthetic rubber.

B. NBR: Acrylonitrile-butadiene rubber.

C. PE: Polyethylene plastic.

1.3 SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For the following:

1. Pipes, fittings, and valves.
2. Dielectric fittings.
3. Flexible pipe connectors.
4. Safety valves.
5. Pressure regulators. Include rated capacities and operating characteristics.
6. Automatic drain valves.
7. Filters. Include rated capacities and operating characteristics.
8. Lubricators. Include rated capacities and operating characteristics.
9. Quick couplings.
10. Hose assemblies.
11. Hose Reels
12. Glad hand connection adapter hoses.

C. Brazing and welding certificates.

D. Qualification Data: For Installers.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For general-service compressed-air piping specialties to include in emergency, operation, and maintenance manuals.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Compressed-air piping and support and installation shall withstand effects of seismic events determined according to ASCE 7, Minimum Design Loads for Buildings and Other Structures.

1.5 QUALITY ASSURANCE

A. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications," or to AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."

B. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

C. ASME Compliance:

1. Comply with ASME B31.1, "Power Piping," for high-pressure compressed-air piping.
2. Comply with ASME B31.9, "Building Services Piping," for low-pressure compressed-air piping.

1.6 WARRANTY

A. Refer to Form 816 Article 1.20-1.06.08 and NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Refer to Form 816 Article 1.06.03 and Form 816 Article 1.20-1.06.03 for additional information.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

A. Schedule 40, Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B, black or hot-dip zinc coated with ends threaded according to ASME B1.20.1.

1. Steel Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, galvanized seamless steel pipe. Include ends matching joining method.
2. Malleable-Iron Fittings: ASME B16.3, Class 150 or 300, threaded.
3. Malleable-Iron Unions: ASME B16.39, Class 150 or 300, threaded.
4. Steel Flanges: ASME B16.5, Class 150 or 300, carbon steel, threaded.

5. Wrought-Steel Butt-Welding Fittings: ASME B16.9, Schedule 40.
6. Steel Flanges: ASME B16.5, Class 150 or 300, carbon steel.

B. Copper Tube: ASTM B 88, Type K or L (ASTM B 88M, Type A or B) and ASTM B 88, Type M (ASTM B 88M, Type C) seamless, drawn-temper, water tube.

1. Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type or MSS SP-73, wrought copper with dimensions for brazed joints.
2. Cast-Copper-Alloy Flanges: ASME B16.24, Class 150 or 300.
3. Copper Unions: ASME B16.22 or MSS SP-123.

C. Transition Couplings for Metal Piping: Metal coupling or other manufactured fitting same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

2.2 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for compressed-air piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Plastic Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated.

F. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.3 VALVES

A. Metal Ball, Butterfly, Check, Gate, and Globe Valves: Comply with requirements in Division 22 Section 22 05 23 "General-Duty Valves for Plumbing Piping."

2.4 DIELECTRIC FITTINGS

A. General Requirements for Dielectric Fittings: Combination fitting of copper alloy and ferrous materials with insulating material; suitable for system fluid, pressure, and temperature. Include threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Dielectric Unions: Factory-fabricated union assembly, for 300-psig minimum working pressure at 180 deg F.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      a. Capitol Manufacturing Company.
      b. Central Plastics Company.
      c. EPCO Sales, Inc.
      d. Hart Industries International, Inc.
      e. Watts Water Technologies, Inc.; Water Products Div.
      f. Zurn Plumbing Products Group; Wilkins Div.
      g. Or approved equal.

C. Dielectric Flanges: Factory-fabricated companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      a. Capitol Manufacturing Company.
      b. Central Plastics Company.
      c. EPCO Sales, Inc.
      d. Watts Water Technologies, Inc.; Water Products Div.
      e. Or approved equal.

D. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

   1. Separate companion flanges and steel bolts and nuts shall have 300-psig minimum working pressure.
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      a. Advance Products & Systems, Inc.
      b. Calpico, Inc.
      c. Central Plastics Company.
      d. Pipeline Seal and Insulator, Inc.
      e. Or approved equal.

2.5 FLEXIBLE PIPE CONNECTORS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

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

   1. Flex-Hose Co., Inc.
   2. Flexicraft Industries.
   3. Hyspan Precision Products, Inc.

4. Mercer Rubber Co.
5. Metraflex, Inc.
6. Proco Products, Inc.
7. Unaflex, Inc.
8. Universal Metal Hose; a Hyspan Company
9. Or approved equal.

C. Bronze-Hose Flexible Pipe Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.

1. Working-Pressure Rating: 300 psig minimum.
2. End Connections, NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.

D. Stainless-Steel-Hose Flexible Pipe Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.

1. Working-Pressure Rating: 300 psig minimum.
2. End Connections, NPS 2 and Smaller: Threaded steel pipe nipple.

2.6 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.

2.7 ESCUTCHEONS

A. General Requirements: Manufactured wall and ceiling escutcheons and floor plates, with ID to closely fit around pipe and tube and OD that completely covers opening.

B. One-Piece, Deep-Pattern Escutcheons: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Escutcheons: With set screw.

1. Finish: Polished chrome-plated.

2.8 SPECIALTIES

A. Safety Valves: ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," construction; National Board certified, labeled, and factory sealed; constructed of bronze body with poppet-type safety valve for compressed-air service.

1. Pressure Settings: Higher than discharge pressure and same or lower than receiver pressure rating.

B. Air-Main Pressure Regulators: Bronze body, direct acting, spring-loaded manual pressure-setting adjustment, and rated for 250-psig inlet pressure, unless otherwise indicated.

1. Type: Pilot operated.

C. Air-Line Pressure Regulators: Diaphragm operated, bronze body, direct acting, spring-loaded manual pressure-setting adjustment, and rated for 300-psig minimum inlet pressure, unless otherwise indicated.

D. Air Dryer Pre-Filters: General purpose filter capable of removing particles down to 1 micron including coalesced liquid water and oil, providing a maximum remaining oil aerosol of 0.5 mg/cubic meter at 21 degrees C. Body shall be metallic body, plastic is not permitted. Provide integral differential pressure gauge to indicate when selected maximum pressure drop has been exceeded. Provide automatic drain. Filter shall be rated for 300 psig inlet pressure.

E. Air Dryer After-Filters: High efficiency filter capable of removing particles down to 0.01 micron including water and oil aerosols, providing a maximum remaining oil aerosol of 0.01 mg/cubic meter at 21 degrees C. Body shall be metallic body, plastic is not permitted. Provide integral differential pressure gauge to indicate when selected maximum pressure drop has been exceeded. Provide automatic drain. Filter shall be rated for 300 psig inlet pressure.

F. Air Tool Station Pressure Regulators: Diaphragm operated, bronze, aluminum alloy, or metallic body, direct acting, spring-loaded manual pressure-setting adjustment, and rated for 300-psig minimum inlet pressure, unless otherwise indicated. Body shall be metallic, plastic construction is not permitted.

G. Automatic Drain Valves: Stainless-steel body and internal parts, rated for 300-psig minimum working pressure, capable of automatic discharge of collected condensate. Include mounting brackets where necessary to support unit.

H. Air Tool Station Mechanical Filters: Two-stage, mechanical-separation-type, air-line filters with 3/4” port size. Filter unit shall be rated for 250 psig. Equip with deflector plates, resin-impregnated-ribbon-type filters with edge filtration, and automatic drain. Filter element shall remove particles down to 5 micron. Body and bowl shall be metallic, plastic construction is not permitted. Include mounting brackets where necessary to support unit.

I. Air Tool Station Lubricators: With drip chamber and sight gauge; with oil-feed adjustment screw and quick-release collar for easy bowl removal. Bowl capacity shall be 64 ounces. Include mounting brackets if necessary. Body and bowl shall be aluminum construction and rated for 300 psig. Plastic construction is not permitted.

2.9 QUICK COUPLINGS

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

1. Aeroquip Corporation; Eaton Corp.
2. Bowes Manufacturing Inc.
3. Foster Manufacturing, Inc.
4. Milton Industries, Inc.

5. Parker Hannifin Corp.; Fluid Connectors Group; Quick Coupling Div.
6. Schrader-Bridgeport; Amflo Div.
7. Schrader-Bridgeport/Standard Thomson.
8. Snap-Tite, Inc.; Quick Disconnect & Valve Division.
9. TOMCO Products Inc.
10. Tuthill Corporation; Hansen Coupling Div.
11. Or approved equal.

B. General Requirements for Quick Couplings: Assembly with locking-mechanism feature for quick connection and disconnection of compressed-air hose.

C. Automatic-Shutoff Quick Couplings: Straight-through brass body with O-ring or gasket seal and stainless-steel or nickel-plated-steel operating parts.

1. Socket End: With one-way valve and threaded inlet for connection to piping or threaded hose fitting.
2. Plug End: Flow-sensor-bleeder, check-valve type with barbed outlet for attaching hose.

2.10 HOSE ASSEMBLIES

A. Description: Compatible hose, clamps, couplings, and splicers suitable for compressed-air service, of nominal diameter indicated, and rated for 300-psig minimum working pressure, unless otherwise indicated.

1. Hose: Reinforced double-wire-braid, CR-covered hose for compressed-air service.
2. Hose Clamps: Stainless-steel clamps or bands.
3. Hose Couplings: Two-piece, straight-through, threaded brass or stainless-steel O-ring or gasket-seal swivel coupling with barbed ends for connecting two sections of hose.
4. Hose Splicers: One-piece, straight-through brass or stainless-steel fitting with barbed ends for connecting two sections of hose.

2.11 GLAD HAND ADAPTER HOSE ASSEMBLIES (TYPE 2 AIR STATIONS)

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

1. New York Air Brake
2. Or approved equal.

B. General Requirements for Glad Hand Connection Adapter Hose Assemblies: Shall be minimum of 48” long and rated for 300 psig. Provide glad hand connection on one end and quick coupling compatible with the hose connection provided on the hose specified in Paragraph 2.10.A. Provide hose hanger support strap. Hose assembly shall comply with applicable American Association of Railroads specifications for air brake hoses.

2.12 HOSE REELS

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

1. Reelcraft Industries
2. Cox Reels
3. Hosetract Industries
4. Lincoln Industrial
5. Or approved equal.

B. Description: Hose reel assemblies for compressed air service and rated for 300 psig working pressure unless otherwise indicted.

1. Drive Mechanism: Spring loaded and enclosed for protection.
2. Finish: Power coated.
3. Connection Points: Swivel and hose inlet connection sealed.
4. Frame: Heavy duty welded steel frame.
5. Hose Arm Guide: Adjustable positions to permit wall, column, or ceiling mounting.
6. Swivel Bracket: To permit wall mounting and allow reel assembly to swing through a range of motion of 180 degrees.
7. Hose Length: Hose length of 50 feet shall be provided in accordance with Paragraph 2.10.
8. Hose Diameter: ½" Inner Diameter.
9. Hose Stop: Bumper type of stop to prevent hose from fully recoiling.
10. Guide Assembly: Roller guides mounted on the hose guide arm.

2.13 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Compressed-Air Piping between Air Compressors and Receivers: Use one of the following piping materials for each size range:

1. NPS 2 and Smaller: Schedule 40, galvanized-steel pipe; threaded, malleable-iron fittings; and threaded joints.
2. NPS 2 and Smaller: Schedule 40, black-steel pipe; wrought-steel fittings; and welded joints.

B. High and Low-Pressure Compressed-Air Distribution Piping: Use one of the following piping materials for each size range:

1. NPS 2 and Smaller: Schedule 40, black-steel pipe; threaded, malleable-iron fittings; and threaded joints.
2. NPS 2 and Smaller: Schedule 40, black-steel pipe; wrought-steel fittings; and welded joints.

C. Drain Piping: Use the following piping materials:

1. NPS 2 and Smaller: Type M copper tube; wrought-copper fittings; and brazed or soldered joints.

3.2 VALVE APPLICATIONS

A. General-Duty Valves: Comply with requirements in Division 22 Section 22 05 23 "General-Duty Valves for Plumbing Piping" for metal general-duty valves. Use metal valves, unless otherwise indicated.

1. Metal General-Duty Valves: Use valve types specified in "Valve Applications" Article in Division 22 Section 22 05 23 "General-Duty Valves for Plumbing Piping" according to the following:

a. High-Pressure Compressed Air: Valve types specified for medium-pressure compressed air.
b. Equipment Isolation NPS 2 and Smaller: Safety-exhaust, copper-alloy ball valve with exhaust vent and pressure rating at least as great as piping system operating pressure.

3.3 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of compressed-air piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, air-compressor sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Plans.

B. Install piping concealed from view and protected from physical contact by building occupants, unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited, unless otherwise indicated.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and to coordinate with other services occupying that space.

E. Install piping adjacent to equipment and machines to allow service and maintenance.

F. Install air and drain piping with 1 percent slope downward in direction of flow.

G. Install piping with PE sheathing for all piping locations that are to be embedded in concrete. Piping sections that are to be embedded in concrete shall be leak tested prior to embedment.

H. Install nipples, flanges, unions, transition and special fittings, and valves with pressure ratings same as or higher than system pressure rating, unless otherwise indicated.

I. Equipment and Specialty Flanged Connections:

1. Use steel companion flange with gasket for connection to steel pipe.
2. Use cast-copper-alloy companion flange with gasket and brazed or soldered joint for connection to copper tube. Do not use soldered joints for connection to air compressors or to equipment or machines producing shock or vibration.

J. Flanged joints may be used instead of specified joint for any piping or tubing system.

K. Install eccentric reducers where compressed-air piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.

L. Install branch connections to compressed-air mains from top of main. Provide drain leg and drain trap at end of each main and branch and at low points.

M. Install thermometer and pressure gage on discharge piping from each air compressor and on each receiver. Comply with requirements in Division 22 Section 22 05 19 "Meters and Gages for Plumbing Piping."

N. Install piping to permit valve servicing.

O. Install piping free of sags and bends.

P. Install fittings for changes in direction and branch connections.

Q. Install seismic restraints on piping. Seismic-restraint devices are specified in Division 22 Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

3.4 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Welded Joints for Steel Piping: Join according to AWS D10.12/D10.12M.

E. Brazed Joints for Copper Tubing: Join according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.

F. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Join according to ASTM B 828 or CDA's "Copper Tube Handbook."

G. Extruded-Tee Outlets for Copper Tubing: Form branches according to ASTM F 2014, with tools recommended by procedure manufacturer, and using operators qualified according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Use asbestos-free, nonmetallic gasket suitable for compressed air. Join flanges with gasket and bolts according to ASME B31.9 for bolting procedure.

I. Dissimilar Metal Piping Material Joints: Use dielectric fittings.

3.5 VALVE INSTALLATION

A. General-Duty Valves: Comply with requirements in Division 22 Section 22 05 23 "General-Duty Valves for Plumbing Piping."

B. Install shutoff valves and unions or flanged joints at compressed-air piping to air compressors.

C. Install shutoff valve at the inlet to branch from the main loop and isolation valves in the loop on both sides of the branch pipe location.

D. Install safety exhaust shutoff valves at inlet to each type of air station (filter, lubricator, and pressure regulator). Install shutoff valves to isolate air dryers, air receivers, and main filters. Upstream isolation valve shall be safety exhaust type.

E. Install check valves to maintain correct direction of compressed-air flow to and from compressed-air piping specialties and equipment.

3.6 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. NPS 2 and Smaller: Use dielectric unions.

3.7 FLEXIBLE PIPE CONNECTOR INSTALLATION

A. Install flexible pipe connectors in discharge piping of each air compressor.

B. Install bronze-hose flexible pipe connectors in copper compressed-air tubing.

C. Install stainless-steel-hose flexible pipe connectors in steel compressed-air piping.

D. Install stainless steel hose flexible pipe connectors between hose reel and compressed air system piping. Hose shall be sufficient in length to permit hose reel to swivel over full area of travel.

3.8 SPECIALTY INSTALLATION

A. Install safety valves on receivers in quantity and size to relieve at least the capacity of connected air compressors.

B. Install air-main pressure regulators in compressed-air piping at or near air compressors.

C. Install air pressure regulators in all branch piping at air tool stations and hose reels.

D. Install automatic drain valves on aftercoolers, receivers, and dryers. Discharge condensate onto nearest floor drain.

E. Install air dryer pre-dryer filter in the piping between each compressor unit and each air dryer. The filter installation location and arrangement shall be selected such that there are no obstructions that impede the filter element removal and replacement.

F. Install air dryer after filter in the piping after each air dryer prior to the header and distribution piping. The filter installation location and arrangement shall be selected such that there are no obstructions that impede the filter element removal and replacement.

G. Install coalescing filters at painting stations. Mount on wall or column at locations indicated. The filter installation location and arrangement shall be selected such that there are no obstructions that impede the filter element removal and replacement.

H. Install coalescing filters in compressed-air piping at or near air compressors and upstream from mechanical filters. Mount on wall or column at locations indicated. The filter installation location and arrangement shall be selected such that there are no obstructions that impede the filter element removal and replacement.

I. Install mechanical filters in compressed-air piping at or near air compressors and downstream from coalescing filters. Mount on wall or column at locations indicated**.** The filter installation location and arrangement shall be selected such that there are no obstructions that impede the filter element removal and replacement.

J. Install mechanical filters and air-line lubricators in all branch piping to air tool stations and hose reels. Mount on wall or columns at locations indicated**.** The filter installation location and arrangement shall be selected such that there are no obstructions that impede the filter element removal and replacement.

K. Install quick couplings at piping terminals for hose connections.

L. Install hose reels with hose assemblies at hose reel locations. Branch piping connection to hose reels shall be flexible connection that allows hose reel to swivel over its full area of travel.

3.9 CONNECTIONS

A. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment and machine.

3.10 SLEEVE INSTALLATION

A. Sleeves are not required for core-drilled holes.

B. Permanent sleeves are not required for holes formed by removable PE sleeves.

C. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs using galvanized-steel pipe.

D. Install sleeves for pipes passing through concrete and masonry walls, gypsum board partitions, and concrete floor and roof slabs.

1. Wall Penetrations: Cut sleeves to length for mounting flush with both surfaces.
2. Floor Penetrations: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

E. Install sleeves in new walls and slabs as new walls and slabs are constructed.

F. Install pipe sleeve at all penetrations where embedded piping is required. Grout compressed air piping in place inside pipe sleeve.

G. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

1. Galvanized Steel Pipe Sleeves: For pipes smaller than NPS 6.
2. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Comply with requirements in Division 07 Section 07 60 00 "Flashing and Sheet Metal" for flashing.

    a. Seal space outside of sleeve fittings with grout.

H. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 07 Section "Firestopping."

3.11 ESCUTCHEON INSTALLATION

A. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

1. New Piping:

    a. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
    b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, stamped steel with set screw.
    c. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece or split plate, stamped steel with set screw, Split plate, stamped steel with set screw.
    d. Bare Piping in Unfinished Service Spaces: One piece, stamped steel with set screw.
    e. Bare Piping in Equipment Rooms: One piece, stamped steel with set screw.

f. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.

3.12 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements in Division 22 Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.

B. Comply with requirements in Division 22 Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices.

C. Vertical Piping: MSS Type 8 or 42, clamps.

D. Individual, Straight, Horizontal Piping Runs:

1. 100 Feet or Less: MSS Type 1, adjustable, steel clevis hangers.
2. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.

E. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.

F. Base of Vertical Piping: MSS Type 52, spring hangers.

G. Support horizontal piping within 12 inches of each fitting and coupling.

H. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

I. Install hangers for Schedule 40, steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1/4 to NPS 1/2: 96 inches with 3/8-inch rod.
2. NPS 3/4 to NPS 1-1/4: 84 inches with 3/8-inch rod.
3. NPS 1-1/2: 12 feet with 3/8-inch rod.
4. NPS 2: 13 feet with 3/8-inch rod.

J. Install supports for vertical, Schedule 40, steel piping every 15 feet.

K. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1/4: 60 inches with 3/8-inch rod.
2. NPS 3/8 and NPS 1/2: 72 inches with 3/8-inch rod.
3. NPS 3/4: 84 inches with 3/8-inch rod.
4. NPS 1: 96 inches with 3/8-inch rod.
5. NPS 1-1/4: 108 inches with 3/8-inch rod.
6. NPS 1-1/2: 10 feet with 3/8-inch rod.
7. NPS 2: 11 feet with 3/8-inch rod.

L. Install supports for vertical copper tubing every 10 feet.

3.13 LABELING AND IDENTIFICATION

A. Install identifying labels and devices for general-service compressed-air piping, valves, and specialties. Comply with requirements in Division 22 Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.14 FIELD QUALITY CONTROL

A. Perform field tests and inspections in accordance with Form 816 Article 1.20-1.05.10 and as follows:

B. Tests and Inspections:

1. Piping Leak Tests for Metal Compressed-Air Piping: Test new and modified parts of existing piping. Cap and fill general-service compressed-air piping with oil-free dry air or gaseous nitrogen to pressure of 50 psig above system operating pressure, but not less than 225 psig. Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
2. Repair leaks and retest until no leaks exist.
3. Inspect filters, lubricators, and pressure regulators for proper operation.

C. Prepare test reports.

END OF SECTION 22 15 13

SECTION 23 11 23 - FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipes, tubes, and fittings.
2. Piping specialties.
3. Piping and tubing joining materials.
4. Valves.
5. Pressure regulators.
6. Service meters.
7. Mechanical sleeve seals.
8. Grout.
9. Concrete bases.

1.2 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. WOG: Water, oil, gas.

1.3 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:

1. Piping and Valves: 100 psig minimum unless otherwise indicated.
2. Service Regulators: 65 psig minimum unless otherwise indicated.

B. Delegated Design: Design restraints and anchors for natural-gas piping and equipment, including comprehensive engineering analysis by a qualified professional engineer licensed in the State of Connecticut, using performance requirements and design criteria indicated.

1.4 SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of the following:

1. Piping specialties.
2. Corrugated, stainless-steel tubing with associated components.
3. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
4. Pressure regulators. Indicate pressure ratings and capacities.
5. Service meters. Indicate pressure ratings and capacities. Include bypass fittings, supports, and meter bars.
6. Dielectric fittings.
7. Mechanical sleeve seals.
8. Escutcheons.

C. Shop Drawings: For facility natural-gas piping layout. Include plans, piping layout and elevations, sections, and details for fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

1. Shop Drawing Scale: 1/8 inch per foot.
2. Detail mounting, supports, and valve arrangements for service meter assembly and pressure regulator assembly.

D. Delegated-Design Submittal: For natural-gas piping and equipment 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 seismic restraints.
2. Design Calculations: Calculate requirements for selecting seismic restraints.

E. Coordination Plans: Plans and details, drawn to scale, on which natural-gas piping is shown and coordinated with other installations, using input from installers of the items involved including:

1. Fire Protection Piping (wet and dry sprinkler systems, standpipes).
2. Domestic water piping (service, hot, cold and tempered water, and sanitary piping systems).
3. Gas Piping.
4. Compressed air piping.
5. HVAC hydronic piping and ducting.
6. Items penetrating finished ceiling include the following:
   a. Lighting fixtures.
   b. Air outlets and inlets.
7. Industrial equipment, bridge cranes, etc

F. Site Survey: Plans, drawn to scale, on which natural-gas piping is shown and coordinated with other services and utilities.

G. Qualification Data: For qualified professional engineer.

H. Welding certificates.

I. Field quality-control reports.

J. Operation and Maintenance Data: For motorized gas valves, pressure regulators and service meters to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Steel Support 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.

C. 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.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Refer to Form 816 Article 1.06.03 and Form 816 Article 1.20-1.06.03 for additional information.

B. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.

C. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

D. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.

1.7 PROJECT CONDITIONS

A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.

B. Interruption of Existing Natural-Gas Service: Do not interrupt natural-gas service to facilities occupied by Department or others unless permitted under the following conditions and then only after arranging to provide purging and startup of natural-gas supply according to requirements indicated:

1. Notify Department no fewer than five days in advance of proposed interruption of natural-gas service.
2. Do not proceed with interruption of natural-gas service without Department's written permission.

1.8 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

B. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces. Comply with requirements in Division 08 Section 08 31 00 "Access Doors and Panels."

1.9 WARRANTY

A. Refer to Form 816 Article 1.20-1.06.08 and NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.

1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

    a. Material Group: 1.1.
    b. End Connections: Threaded or butt welding to match pipe.
    c. Lapped Face: Not permitted underground.
    d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
    e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.

5. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.

    a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.

2.2 PIPING SPECIALTIES

A. Appliance Flexible Connectors:

1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.

4. Corrugated stainless-steel tubing with polymer coating.
5. Operating-Pressure Rating: 0.5 psig.
6. End Fittings: Zinc-coated steel.
7. Threaded Ends: Comply with ASME B1.20.1.
8. Maximum Length: 72 inches.

B. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.3 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.

B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

2.4 MANUAL GAS SHUTOFF VALVES

A. See "Aboveground Manual Gas Shutoff Valve Schedule" Article for where each valve type is applied in various services.

B. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.

1. CWP Rating: 125 psig.
2. Threaded Ends: Comply with ASME B1.20.1.
3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
4. Tamperproof Feature: Locking feature for valves indicated in "Aboveground Manual Gas Shutoff Valve Schedule" Article.
5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
6. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.

C. General Requirements for Metallic Valves, NPS 2-1/2 and Larger: Comply with ASME B16.38.

1. CWP Rating: 125 psig.
2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
3. Tamperproof Feature: Locking feature for valves indicated in "Aboveground Manual Gas Shutoff Valve Schedule" Article.
4. Service Mark: Initials "WOG" shall be permanently marked on valve body.

D. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.

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

    a. BrassCraft Manufacturing Company; a Masco company.
    b. Conbraco Industries, Inc.; Apollo Div.
    c. Lyall, R. W. & Company, Inc.
    d. McDonald, A. Y. Mfg. Co.
    e. Perfection Corporation; a subsidiary of American Meter Company.
    f. Or Approved Equal

2. Body: Bronze, complying with ASTM B 584.
3. Ball: Chrome-plated bronze.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Packing: Threaded-body packnut design with adjustable-stem packing.
7. Ends: Threaded, flared, or socket as indicated in “Underground Manual Gas Shutoff Valve Schedule” and “Aboveground Manual Gas Shutoff Valve Schedule” Articles.
8. CWP Rating: 600 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with “WOG” indicated on valve body.

E. Bronze Plug Valves: MSS SP-78.

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

    a. Lee Brass Company.
    b. McDonald, A. Y. Mfg. Co.
    c. Or approved equal.

2. Body: Bronze, complying with ASTM B 584.
3. Plug: Bronze.
4. Ends: Threaded, socket, or flanged as indicated in "Aboveground Manual Gas Shutoff Valve Schedule" Article.
5. Operator: Square head or lug type with tamperproof feature where indicated.
6. Pressure Class: 125 psig.
7. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

F. Cast-Iron, Nonlubricated Plug Valves: MSS SP-78.

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

    a. McDonald, A. Y. Mfg. Co.
    b. Mueller Co.; Gas Products Div.

c. Xomox Corporation; a Crane company.
d. Or approved equal.

2. Body: Cast iron, complying with ASTM A 126, Class B.
3. Plug: Bronze or nickel-plated cast iron.
4. Seat: Coated with thermoplastic.
5. Stem Seal: Compatible with natural gas.
6. Ends: Threaded or flanged as indicated in "Aboveground Manual Gas Shutoff Valve Schedule" Article.
7. Operator: Square head or lug type with tamperproof feature where indicated.
8. Pressure Class: 125 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

2.5 PRESSURE REGULATORS

A. General Requirements:

1. Single stage and suitable for natural gas.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 and smaller; flanged for regulators NPS 2-1/2 and larger.

B. Service Pressure Regulators: Will be provided and installed by Southern Connecticut Gas Company.

C. Line Pressure Regulators: Comply with ANSI Z21.80.

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

a. Actaris.
b. American Meter Company.
c. Eclipse Combustion, Inc.
d. Fisher Control Valves and Regulators; Division of Emerson Process Management.
e. Invensys.
f. Maxitrol Company.
g. Richards Industries; Jordan Valve Div.
h. Or approved equal.

2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.

8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
10. Overpressure Protection Device: Factory mounted on pressure regulator.
11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
12. Maximum Inlet Pressure: 5 psig.
13. Pressure Settings: IWT Building Gas System Line Regulator: 1 psi
Emergency Generator System Line Regulator: 2 psi

D. Appliance Pressure Regulators: Comply with ANSI Z21.18.

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

a. Canadian Meter Company Inc.
b. Eaton Corporation; Controls Div.
c. Harper Wyman Co.
d. Maxitrol Company.
e. SCP, Inc.
f. Or approved equal.

2. Body and Diaphragm Case: Die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber.
6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
7. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
8. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
9. Maximum Inlet Pressure: 5 psig.

2.6 SERVICE METERS

A. Service Meters: Will be provided and installed by Southern Connecticut Gas Company.

2.7 DIELECTRIC FITTINGS

A. Dielectric Unions:

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

a. Capitol Manufacturing Company.
b. Central Plastics Company.
c. Hart Industries International, Inc.
d. McDonald, A. Y. Mfg. Co.
e. Watts Regulator Co.; Division of Watts Water Technologies, Inc.

f. Wilkins; Zurn Plumbing Products Group.
g. Or approved equal.

2. Minimum Operating-Pressure Rating: 150 psig.
3. Combination fitting of copper alloy and ferrous materials.
4. Insulating materials suitable for natural gas.
5. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

B. Dielectric Flanges:

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

a. Capitol Manufacturing Company.
b. Central Plastics Company.
c. Watts Regulator Co.; Division of Watts Water Technologies, Inc.
d. Wilkins; Zurn Plumbing Products Group.
e. Or approved equal.

2. Minimum Operating-Pressure Rating: 150 psig.
3. Combination fitting of copper alloy and ferrous materials.
4. Insulating materials suitable for natural gas.
5. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

C. Dielectric-Flange Kits:

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

a. Advance Products & Systems, Inc.
b. Calpico Inc.
c. Central Plastics Company.
d. Pipeline Seal and Insulator, Inc.
e. Or approved equal

2. Minimum Operating-Pressure Rating: 150 psig.
3. Companion-flange assembly for field assembly.
4. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or PE bolt sleeves, phenolic washers, and steel backing washers.
5. Insulating materials suitable for natural gas.
6. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

2.8 SLEEVES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

2.9 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

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

    a. Advance Products & Systems, Inc.
    b. Calpico Inc.
    c. Metraflex Company (The).
    d. Pipeline Seal and Insulator, Inc.
    e. Or approved equal

2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe and sleeve.
3. Pressure Plates: Stainless steel.
4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one nut and bolt for each sealing element.

2.10 ESCUTCHEONS

A. General Requirements for Escutcheons: Manufactured wall and ceiling escutcheons and floor plates, with ID to fit around pipe or tube, and OD that completely covers opening.

B. One-Piece, Deep-Pattern Escutcheons: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Escutcheons: With set screw.

1. Finish: Polished chrome-plated.

2.11 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

2.12 LABELING AND IDENTIFYING

A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick,

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.

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

3.2 PREPARATION

A. Close equipment shutoff valves before turning off natural gas to premises or piping section.

B. Inspect natural-gas piping according to Connecticut Gas Equipment and Piping Code, and NFPA 54 to determine that natural-gas utilization devices are turned off in piping section affected.

C. Comply with Connecticut Gas Equipment and Piping Code, and NFPA 54 requirements for prevention of accidental ignition.

3.3 OUTDOOR PIPING INSTALLATION

A. Comply with Connecticut Gas Equipment and Piping Code, and NFPA 54 for installation and purging of natural-gas piping.

B. Install underground, natural-gas piping buried at least 36 inches below finished grade.

1. If natural-gas piping is installed less than 36 inches below finished grade, install it in containment conduit.

C. Steel Piping with Protective Coating:

1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
3. Replace pipe having damaged PE coating with new pipe.

D. Install fittings for changes in direction and branch connections.

E. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches in diameter.

2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.

F. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

G. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

H. Install pressure gage upstream and downstream from each service regulator. Pressure gages are specified in Division 23 Section 23 09 00 "Instrumentation and Controls for HVAC."

3.4 INDOOR PIPING INSTALLATION

A. Comply with Connecticut Gas Equipment and Piping Code, and NFPA 54 for installation and purging of natural-gas piping.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Plans.

C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Locate valves for easy access.

G. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install escutcheons at penetrations of interior walls, ceilings, and floors.

K. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 07 Section 07 84 00 "Firestopping."

L. Verify final equipment locations for roughing-in.

M. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.

N. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.

1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.

O. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.

P. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

Q. Connect branch piping from top or side of horizontal piping.

R. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.

S. Do not use natural-gas piping as grounding electrode.

T. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.

U. Install pressure gage upstream and downstream from each line regulator. Pressure gages are specified in Division 23 Section 23 09 00 "Instrumentation and Controls for HVAC."

3.5 SERVICE-METER ASSEMBLY INSTALLATION

A. Install service-meter assemblies aboveground**,** on concrete bases where wall mounting is not possible.

B. Install metal shutoff valves upstream from service regulators. Shutoff valves are not required at second regulators if two regulators are installed in series.

C. Install strainer on inlet of service-pressure regulator and meter set.

D. Install service regulators mounted outside with vent outlet horizontal or facing down. Install screen in vent outlet if not integral with service regulator.

E. Install metal shutoff valves upstream from service meters. Install dielectric fittings downstream from service meters.

F. Install service meters downstream from service pressure regulators.

G. Install metal bollards to protect meter assemblies. Comply with requirements in Division 05 Section 05 50 00 "Metal Fabrications" for pipe bollards.

3.6 VALVE INSTALLATION

A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.

B. Install underground valves with valve boxes.

C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

3.7 PIPING JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints:

1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
2. Cut threads full and clean using sharp dies.
3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Welded Joints:

1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
2. Bevel plain ends of steel pipe.
3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

E. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.

3.8 HANGER AND SUPPORT INSTALLATION

A. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Division 23 Section 23 05 48 "Vibration and Seismic Controls for HVAC Piping and Equipment."

B. Comply with requirements for pipe hangers and supports specified in Division 23 Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment."

C. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
4. NPS 2-1/2 to NPS 3-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.
5. NPS 4 and Larger: Maximum span, 10 feet; minimum rod size, 5/8 inch.

3.9 CONNECTIONS

A. Connect to utility's gas main according to utility's procedures and requirements.

B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.

C. Install piping adjacent to appliances to allow service and maintenance of appliances.

D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.

E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.10 LABELING AND IDENTIFYING

A. Comply with requirements in Division 23 Section 23 05 53 "Identification for HVAC Piping and Equipment" for piping and valve identification.

B. Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.11 PAINTING

A. Comply with requirements in Division 09 Sections 09 91 00 “Painting” for painting exterior natural-gas piping.

B. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.

1. Alkyd System: MPI EXT 5.1D.

    a. Prime Coat: Alkyd anticorrosive metal primer.
    b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
    c. Topcoat: Exterior alkyd enamel semigloss.
    d. Color: Gray.

C. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.12 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to seismic codes at Project.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting plans, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Use 3000-psig, 28-day, compressive-strength concrete and reinforcement as specified in Division 03 Section 03 30 00 "Cast-in-Place Concrete."

3.13 FIELD QUALITY CONTROL

A. Perform tests and inspections in accordance with Form 816 Article 1.20-1.05.10 and as follows:

B. Tests and Inspections in accordance with Form 816 Article 1.20-1.05.10 and as follows:

1. Test, inspect, and purge natural gas according to Connecticut Gas Equipment and Piping Code, and NFPA 54 and authorities having jurisdiction.

C. Natural-gas piping will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.14 DEMONSTRATION

A. Refer to Form 816 Article 1.20-1.08.14 subsection 3 for additional information.

B. Engage a factory-authorized service representative to train Department's maintenance personnel to adjust, operate, and maintain earthquake valves.

3.15 OUTDOOR PIPING SCHEDULE

A. Underground natural-gas piping shall be the following:

1. Steel pipe with wrought-steel fittings and welded joints, or mechanical couplings. Coat pipe and fittings with protective coating for steel piping.

B. Aboveground natural-gas piping shall be one of the following:

1. Piping less than 2-1/2”, steel pipe with malleable-iron fittings and threaded joints.
2. Piping 2-1/2” and larger, steel pipe with wrought-steel fittings and welded joints.

C. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

3.16 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 5 PSIG

A. Aboveground, branch piping NPS 1 and smaller shall be the following:

1. Steel pipe with malleable-iron fittings and threaded joints.

B. Aboveground, distribution piping shall be one of the following:

1. Piping less than 2-1/2", steel pipe with malleable-iron fittings and threaded joints.
2. Piping 2-1/2" and larger, steel pipe with wrought-steel fittings and welded joints.

C. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

D. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping.

3.17 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Valves for pipe sizes NPS 2 and smaller at service meter shall be the following:

1. Bronze plug valve.

B. Valves for pipe sizes NPS 2-1/2 and larger at service meter shall be one of the following:

1. Two piece, full port, bronze ball valves with bronze trim.
2. Bronze plug valve.
3. Cast-iron, nonlubricated plug valve.

C. Distribution piping valves for pipe sizes NPS 2 and smaller shall be the following:
1. Bronze plug valve.

D. Distribution piping valves for pipe sizes NPS 2-1/2 and larger shall be one of the following:

1. Bronze plug valve.
2. Cast-iron, nonlubricated plug valve.

E. Valves in branch piping for single appliance shall be the following:

1. Bronze plug valve.

END OF SECTION 23 11 23

SECTION 23 72 00 - AIR-TO-AIR ENERGY RECOVERY EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Packaged rooftop air to air energy recovery units with roof curbs, direct fired gas furnaces, supply and exhaust fans, energy wheel, filters, control dampers, controls etc.

1.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design vibration isolation and seismic-restraint details, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Seismic and Wind Performance: Air-to-air energy recovery equipment shall withstand the effects of earthquake motions and wind per the criteria referenced in specification Section 23 05 48 “Vibration and Seismic Controls for HVAC Piping and Equipment.”

1. 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."

1.3 SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated. Include rated capacities, furnished specialties, and accessories.

C. Shop Drawings: For air-to-air energy recovery equipment. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

D. Delegated-Design Submittal: For air-to-air energy recovery equipment including analysis data signed and sealed by the qualified professional engineer licensed in the State of Connecticut responsible for their preparation.

1. Detail fabrication and assembly of air-to-air energy recovery equipment.
2. 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.
3. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.

E. Seismic Qualification Certificates: For air-to-air energy recovery equipment, accessories, and components, from manufacturer.

F. Operation and maintenance data.

1.4 QUALITY ASSURANCE

A. 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.

B. ARI Compliance: Capacity ratings for air-to-air energy recovery equipment shall comply with ARI 1060, "Rating Air-to-Air Energy Recovery Equipment."

C. ASHRAE Compliance:

1. Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
2. Capacity ratings for air-to-air energy recovery equipment shall comply with ASHRAE 84, "Method of Testing Air-to-Air Heat Exchangers."

D. UL Compliance: Packaged heat recovery ventilators shall comply with requirements in UL 1812, "Ducted Heat Recovery Ventilators"; or UL 1815, "Nonducted Heat Recovery Ventilators."

1.5 WARRANTY

A. Refer to Form 816 Article 1.20-1.06.08 and NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.

B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of air-to-air energy recovery equipment that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Heat Wheel: 5 years from date of issuance of the Certificate of Compliance.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Refer to Form 816 Article 1.06.03 and Form 816 Article 1.20-1.06.03 for additional information.

1.7 SPARE PARTS

A. Furnish spare parts that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filters; One complete set of spare filters (both supply and return sides) for each energy recovery unit.

PART 2 - PRODUCTS

2.1 PACKAGED ROOFTOP AIR TO AIR ENERGY RECOVERY UNITS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Aaon or a comparable product by one of the following:

1. American Energy Exchange, Inc.
2. Cambridgeport
3. SEMCO Incorporated.
4. Seasons Four
5. Venmar.
6. Marcraft
7. Or Approved equal.

B. General: Provide packaged rooftop air to air energy recovery units complete with vibration isolation seismic roof curbs, direct fired gas furnaces, supply and exhaust fans, energy wheel, filters, control dampers, controls etc. Gas furnaces shall be modulating direct fired type specifically designed for a 100% outside air application. Unit provided shall be designed for outdoor applications. Units shall be completely factory assembled with all associated internal wiring and test fired. Units shall be provided with all operating and safety controls. Units shall include all filters, energy recovery wheels, burners, fans, fresh air hoods, and all optional equipment. Units shall be shipped in one piece unless otherwise specified. Units shall be shipped with all electrical diagrams attached to inside of control cabinet. Units shall be ETL or UL listed.

C. Casing: Base frame to be integral iron channel construction or heavy duty formed steel. The unit casing shall be shall be airtight and waterproof and shall include condensate drain connections in the cooling coil sections. The unit roof and floor construction shall utilize 3-break standing seams to eliminate water leaks.

1. Casing shall be 2" Double Wall Solid, 16-gauge galvanized steel exterior wall, 22-gauge solid galvanized steel liner.
2. Unit shall be equipped with a weather resistant control enclosure housing all controls and gas manifold.
3. The unit shall be equipped with double wall hinged access doors that make the fan, motor, drives, filters, dampers, coils, and controls fully accessible. Unit shall be equipped with piano-hinged access doors for fan and filter sections.
4. Units shall be provided with suitable lifting and anchor holes.
5. Provide stainless steel drain pan.
6. The unit shall be painted as with two-component enamel coating electrostatically applied which meets a 650-hour salt spray test based on the ASTM B117 standard for salt spray resistance.
7. Unit insulation shall be NFPA 90A & 90B approved, 2" thick 1.5 lb./ft² density insulation.

D. Direct Fired Gas Furnace: Comply with ANSI Z83.18 Burner section: Burner shall contain a Maxon NP burner constructed of rust resistant cast iron bodies drilled to discharge the fuel between diverging stainless steel mixing plates. Natural gas is delivered directly to the burner ports at low pressure. The entire burner assembly shall be mounted directly in the air stream being heated. The gas manifold shall be located in the control cabinet outside of the air stream. Units shall be supplied with a wide range burner with a modulating turndown ratio of 30 to 1. An observation port shall be located to provide a view of pilot and main flame. The operation of the burner shall be programmed through the flame safeguard with timed prepurge and flame sensing. Unit controls shall consist of a spark ignition system with flame rod sensing of flame, an adjustment high limit switch (factory set at 185ºF), flame safeguard with alarm contacts, ignition transformer, air proving differential switch, and modulating control system. The burner section shall be manifold individually to accomplish the desired capacity. Gas train shall be designed to FM standards and shall consist of a main manual gas shutoff valve, a motorized electric main gas valve, a Maxitrol modulating gas valve, a manual pilot gas shutoff valve, a manual pilot gas pressure regulator, a pilot gas valve, orificed needle valve and other appurtenances as required to comply with FM standards. The gas valves shall be capable of operating to -10ºF.

E. Supply and Exhaust Fans: Fans shall be individually selected to match external static, sound, efficiency, and space design criteria as specified. Supply and exhaust fans shall be plenum type centrifugal fan dynamically balanced complete with a polished ground shaft. Fan bearings shall be self-aligning pillow block, grease lubricated extra heavy duty, anti-friction ball type, selected for an average life of 60,000 hours at design conditions. All fans shall be rated in accordance with AMCA Standards. Fan assembly and motor shall be mounted on a common base. Fans shall be isolated from casing by a flexible canvas duct. Fans shall be internally isolated from unit with seismic spring isolators Fan section shall have hinged access doors as standard to allow removal of fan shaft and motor for servicing. Motors shall be premium efficiency, mounted on an adjustable base to permit drive belt tensioning. Fan motors shall be provided with factory supplied motor starters, external overload protection, transformer. Drives shall be adjustable to within 10% above or below midpoint r.p.m. up to 5 H.P. Drives will be fixed pitched for 7.5 H.P. and above. Fans shall be provided with extended grease lines.

F. Energy Wheel: Aluminum segmented wheel strengthened with radial spokes. Segmented wheel strengthened with radial spokes impregnated with nonmigrating, water-selective, molecular-sieve desiccant coating. Steel casing with standard factory-painted finish. Integral purge section shall limit carryover of exhaust air to between 0.05 percent at 1.6-inch wg and 0.20 percent at 4-inch wg differential pressure. Provide casing seals on periphery of rotor and on duct divider and purge section. Support vertical rotors on grease-lubricated ball bearings having extended grease fittings or permanently lubricated bearings. Support horizontal rotors on tapered roller bearing.

G. Drive: Fractional horsepower motor and gear reducer, with 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 Division 23 Section 23 05 13 "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.
3. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.

H. Controls:

1. Unit shall be provided with a factory-wired signal conditioner to allow the unit to be controlled by a DDC control system.
2. Unit shall be provided with a clogged filter switch.
3. Unit shall be provided with a 115V convenience outlet factory wired.
4. Provide starting relay, factory mounted and wired, and manual motor starter for field wiring.
5. Provide variable frequency controller, factory mounted and wired, permitting input of field connected 4-20 mA or 1-10-V control signal.
6. Provide variable frequency controller, factory mounted and wired, with exhaust-air sensor to vary rotor speed and maintain exhaust temperature above freezing.
7. Provide variable frequency controller, factory mounted and wired, with exhaust- and outdoor-air sensors, automatic changeover thermostat and set-point adjuster, to vary rotor speed and maintain exhaust temperature above freezing and air differential temperature above set point. Provide maximum rotor speed when exhaust-air temperature is less than outdoor-air temperature.
8. Provide pilot-Light Indicator: Display rotor rotation and speed.
9. Speed Settings: Provide adjustable settings for maximum and minimum rotor speed limits.

I. Extended-Surface, Disposable Panel Filters:

1. Comply with NFPA 90A.
2. Provide minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.

3. Provide 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.
4. Factory-fabricated, dry, extended-surface type.
5. Thickness: 4 inches
6. Dust spot efficiency: 65%.
7. Merv (ASHRAE 52.2): 11.
8. Media: Fibrous material formed into deep-V-shaped pleats and held by self-supporting wire grid.
9. Media-Grid Frame: Galvanized steel.
10. Mounting Frames: Welded, galvanized steel with gaskets and fasteners, suitable for bolting together into built-up filter banks.

2.2 CAPACITIES AND CHARACTERISTICS

A. As indicated on Plans.

2.3 ROOF CURBS

A. Roof curb shall include vibration isolators and wind and seismic restraints and shall be as specified in Division 23 Section 23 05 48 "Vibration and Seismic Controls for HVAC Piping and Equipment."

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.

    a. Materials: ASTM C 1071, Type I or II.
    b. Thickness: 1 inch.

2. Application: Factory applied with adhesive and mechanical fasteners to the internal surface of curb.

    a. Liner Adhesive: Comply with ASTM C 916, Type I.
    b. 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.
    c. Liner materials applied in this location shall have air-stream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric depending on service air velocity.
    d. Liner Adhesive: Comply with ASTM C 916, Type I.

C. Curb Height: As indicated on drawings.

D. Wind and Seismic Restraints: Metal brackets compatible with the curb and casing, painted to match RTU, used to anchor unit to the curb, and designed for loads at Project site. Comply with requirements in Division 23 Section 23 05 48 "Vibration and Seismic Controls for HVAC Piping and Equipment" for wind-load requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units in strict accordance with manufacturer’s recommendations.

B. Install units on vibration isolation seismic roof curbs.

C. Install units with clearances for service and maintenance.

D. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.

3.2 CONNECTIONS

A. Comply with requirements for ductwork specified in Division 23 Section 23 31 13 "Metal Ducts."

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

3.3 DEMONSTRATION

A. Refer to Form 816 Article 1.20-1.08.14 subsection 3 for additional information.

B. Engage a factory-authorized service representative to train the Department's maintenance personnel to adjust, operate, and maintain the air-to-air energy recovery units.

END OF SECTION 23 72 00

SECTION 26 12 00 - MEDIUM-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following types of transformers with medium-voltage primaries:

1. Pad-mounted, liquid-filled transformers.

1.2 DEFINITIONS

A. ATS: Acceptance Testing Specification.

B. NETA: InterNational Electrical Testing Association, Inc.

1.3 SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, location of each field connection, and performance for each type and size of transformer indicated.

C. Shop Drawings: Diagram power wiring.

D. Coordination Plans: Plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Underground primary and secondary conduit stub-up location.
2. Dimensioned concrete base, outline of transformer, and required clearances.
3. Ground rod and grounding cable locations.

E. Manufacturer Seismic Qualification Certification: Submit certification that transformer assembly and components will withstand seismic forces defined in Division 26 Section 26 05 48 "Vibration and Seismic Controls for Electrical Systems".

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 Plans 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.

F. Qualification Data: For testing agency.

G. Source quality-control test reports.

H. Field quality-control test reports.

I. Follow-up service reports.

J. Operation and Maintenance Data: For transformer and accessories to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the testing indicated, that is a member company of the International Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. Product Options: Plans indicate size, profiles, and dimensional requirements of transformers and are based on the specific system indicated.

C. 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.

D. Comply with IEEE C2.

E. Comply with ANSI C57.12.10, ANSI C57.12.28, IEEE C57.12.70, and IEEE C57.12.80.

F. Comply with NFPA 70.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Refer to Form 816 Article 1.06.03 and Form 816 Article 1.20-1.06.03 for additional information.

B. Store transformers so condensation will not form on or in units. Provide temporary heating according to manufacturer's written instructions.

1.6 PROJECT CONDITIONS

A. Service Conditions: IEEE C37.121, usual service conditions except for the following:

1. Exposure to hot and humid climate.
2. Exposure to seismic shock.
3. Exposure to excessively high or low temperatures.

1.7 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.

B. Coordinate installation so no piping or conduits are installed in space allocated for medium-voltage transformers except those directly associated with transformers.

C. Coordinate with Metro North Railroad prior to energization.

1.8 WARRANTY

A. Refer to Form 816 Article 120-1.06.08 and NOTICE TO CONTRACTOR- CLOSEOUT DOCUMENTS for additional information.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper Industries, Cooper Power Systems Division.
2. Cutler-Hammer.
3. Federal Pacific Transformer Company; Division of Electro-Mechanical Corp.
4. GE Electrical Distribution & Control.
5. Siemens Energy & Automation, Inc.
6. Square D; Schneider Electric.
7. Virginia Transformer Corp.
8. Or approved equal.

2.2 PAD-MOUNTED, LIQUID-FILLED TRANSFORMERS

A. Description: ANSI C57.12.13, ANSI C57.12.26, pad-mounted, 2-winding transformers. Stainless-steel tank base and sills.

B. Coils: Continuous copper windings without splices except for taps.

C. Insulating Liquid: Mineral oil, complying with ASTM D 3487, Type II, and tested according to ASTM D 117.

D. Insulation Class and Winding Temperature Rise: 120 C Insulation temperature, with 65 deg C Winding temperature when operated at rated kVA output in a 30 deg C ambient temperature. Transformer shall be rated to operate at rated kilovolt ampere in an average ambient temperature of 30 deg C over 24 hours with a maximum ambient temperature of 40 deg C without loss of service life expectancy.

E. Basic Impulse Level: 95 kV.

F. Full-Capacity Voltage Taps: Four 2.5 percent taps, 2 above and 2 below rated high voltage; with externally operable tap changer for de-energized use and with position indicator and padlock hasp.

G. High-Voltage Terminations and Equipment: Dead front with universal-type bushing wells for dead-front bushing-well inserts, complying with IEEE 386 and including the following:

1. Bushing-Well Inserts: One for each high-voltage bushing well.
2. Surge Arresters: Dead-front, elbow-type, metal-oxide-varistor units.
3. Parking Stands: One for each high-voltage bushing well.
4. Portable Insulated Bushings: Arranged for parking insulated, high-voltage, load-break cable terminators; one for each primary feeder conductor terminating at transformer.

H. Accessories:

1. Drain Valve: 1 inch, with sampling device.
2. Dial-type thermometer.
3. Liquid-level gage.
4. Pressure-vacuum gage.
5. Pressure Relief Device: Self-sealing with an indicator.
6. Mounting provisions for low-voltage current transformers.
7. Mounting provisions for low-voltage potential transformers.

2.3 IDENTIFICATION DEVICES

A. Nameplates: Engraved, laminated-plastic or metal nameplate for each transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Division 26 Section 26 05 53 "Identification for Electrical Systems."

2.4 SOURCE QUALITY CONTROL

A. Factory Tests: Perform design and routine tests according to standards specified for components. Conduct transformer tests according to IEEE C57.12.90 and IEEE C57.12.91.

B. Factory Tests: Perform the following factory-certified tests on each transformer:

1. Resistance measurements of all windings on rated-voltage connection and on tap extreme connections.

2. Ratios on rated-voltage connection and on tap extreme connections.
3. Polarity and phase relation on rated-voltage connection.
4. No-load loss at rated voltage on rated-voltage connection.
5. Excitation current at rated voltage on rated-voltage connection.
6. Impedance and load loss at rated current on rated-voltage connection and on tap extreme connections.
7. Applied potential.
8. Induced potential.
9. Department will witness all required factory tests. Notify The Department at least 14 days before date of tests and indicate their approximate duration.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for medium-voltage transformers.

B. Examine roughing-in of conduits and grounding systems to verify the following:

1. Wiring entries comply with layout requirements.
2. Entries are within conduit-entry tolerances specified by manufacturer and no feeders will have to cross section barriers to reach load or line connections.

C. Examine concrete bases for suitable mounting conditions where transformers will be installed.

D. Verify that ground connections are in place and that requirements in Division 26 Section 26 05 26 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.

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

3.2 INSTALLATION

A. Install transformers on concrete bases.

1. Anchor transformers to concrete bases according to manufacturer's written instructions, seismic codes at Project, and requirements in Division 26 Section 26 05 29 "Hangers and Supports for Electrical Systems."
2. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit and 4 inches high.
3. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section 03 30 00 "Cast-in-Place Concrete."
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting plans, templates, diagrams, instructions, and directions furnished with items to be embedded.

B. Maintain minimum clearances and workspace at equipment according to manufacturer's written instructions and NFPA 70.

3.3 IDENTIFICATION

A. Identify field-installed wiring and components and provide warning signs as specified in Division 26 Section 26 05 53 "Identification for Electrical Systems."

3.4 CONNECTIONS

A. Ground equipment according to Division 26 Section 26 05 26 "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Division 26 Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections in accordance with Form 816 Article 1.20-1.05.10 and as follows:

B. 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.

C. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:

1. After installing transformers but before primary is energized, verify that grounding system at substation is tested at specified value or less.
2. After installing transformers and after electrical circuitry has been energized, test for compliance with requirements.
3. Perform visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Remove and replace malfunctioning units and retest as specified above.

E. Test Reports: Prepare written reports to record the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective actions taken to achieve compliance with requirements.

3.6 FOLLOW-UP SERVICE

A. Voltage Monitoring and Adjusting: If requested by Department, perform the following voltage monitoring after issuance of Certificate of Compliance but not more than six months after issuance of Certificate of Compliance:

1. During a period of normal load cycles as evaluated by Department, perform seven days of three-phase voltage recording at secondary terminals of each transformer. Use voltmeters with calibration traceable to National Institute of Science and Technology standards and with a chart speed of not less than 1 inch per hour. Voltage unbalance greater than 1 percent between phases, or deviation of any phase voltage from nominal value by more than plus or minus 5 percent during test period, is unacceptable.
2. Corrective Actions: If test results are unacceptable, perform the following corrective actions, as appropriate:

    a. Adjust transformer taps.
    b. Prepare written request for voltage adjustment by electric utility.

3. Retests: After corrective actions have been performed, repeat monitoring until satisfactory results are obtained.
4. Report: Prepare written report covering monitoring and corrective actions performed.

B. Infrared Scanning: Perform as specified in Division 26 Section 26 13 00 "Medium-Voltage Switchgear."

END OF SECTION 26 12 00

Memo

TO: Robert Messina, Project Manager, DOT

FROM: Carol Szymanski, OLISP, DEP

DATE: May 27, 2010

RE: Project 300-0139, New Haven Rail Yard Wheel True Facility

Thank you for coordinating the review of the above-referenced proposed project with our office. As you know, pursuant to Section 22a-100 of the Connecticut Coastal Management Act (CCMA), any proposed DOT activities within the coastal boundary that may significantly affect the environment must be fully consistent with the policies and standards of the CCMA. The project site is located entirely within the coastal boundary. Coastal resources on or near the site include coastal hazard area, coastal waters and freshwater wetlands and watercourses.

The proposed project entails construction of a wheel true facility at the New Haven Rail Yard. Best management practices will be employed, including anti-tracking pads, silt fencing and catch basin protection.

In conclusion, we find the proposal consistent. If you have any further questions about this site or any Long Island Sound related issues, please feel free to contact me at (860) 424-3138.

STATE OF CONNECTICUT
DEPARTMENT OF ENVIRONMENTAL PROTECTION

July 22, 2010

Department of Transportation
2800 Berlin Turnpike
Newington, CT 06131

Attn: Mr. Tom Maziarz

Re: FM 201002438
State Project No. 301-0088, 301-0139
New Haven Rail Facilities Projects, Independent Wheel True Facility
New Haven

Dear Mr. Maziarz:

The Inland Water Resources Division of the Department of Environmental Protection has reviewed the flood management certification prepared by Glen Hayden, PE and signed by Tom Maziarz of the Department of Transportation. The certification document dated April 16, 2010 and submitted April 20, 2010, states that the proposed activity has been designed in compliance with the requirements of Section 25-68d(b) of the Connecticut General Statutes (CGS) and Section 25-68h-1 through 25-68h-3 of the Regulations of Connecticut State Agencies (RCSA).

The project consists of the construction of the Independent Wheel True Facility, supporting utilities and stormwater drainage system upgrades as shown on plans entitled "New Haven Rail Yard Facilities Improvements, Independent Wheel True Facility," dated April 2010. This project phase is one component of the larger New Haven Rail Yard Facility Improvements Program (No. 301-0088).

The above referenced certification is hereby approved. No revisions or alterations to the approved plans are allowed without first obtaining written approval from this Division of such alterations. If there are any questions or comments, please contact Daniel Biron of the Inland Water Resources Division at 860-424-3892.

Sincerely,

Denise Ruzicka
Director
Inland Water Resources Division

cc: File

Received
Bureau Chief
JUL 26 2010
Policy and Planning