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June 16, 2023 Letting

Notice to Bidders, Specifications and Proposal

Illinois Department of Transportation

Contract No. 76P08
ST CLAIR County
Section (Z-1)PS-2,29PS-2
Route FAU 9228
District 8 Construction Funds

Prepared by

S

Checked by

(Printed by authority of the State of Illinois)

Illinois Department of Transportation

NOTICE TO BIDDERS

1. **TIME AND PLACE OF OPENING BIDS.** Electronic bids are to be submitted to the electronic bidding system (iCX-Integrated Contractors Exchange). All bids must be submitted to the iCX system prior to 12:00 p.m. June 16, 2023 prevailing time at which time the bids will be publicly opened from the iCX SecureVault.

2. **DESCRIPTION OF WORK**. The proposed improvement is identified and advertised for bids in the Invitation for Bids as:

   Contract No. 76P08
   ST CLAIR County
   Section (Z-1)PS-2,29PS-2
   Route FAU 9228
   District 8 Construction Funds

   Storm water pump station rehab at the 25th Street Pump Station south of I-64.

3. **INSTRUCTIONS TO BIDDERS**. (a) This Notice, the invitation for bids, proposal and letter of award shall, together with all other documents in accordance with Article 101.09 of the Standard Specifications for Road and Bridge Construction, become part of the contract. Bidders are cautioned to read and examine carefully all documents, to make all required inspections, and to inquire or seek explanation of the same prior to submission of a bid.

   (b) State law, and, if the work is to be paid wholly or in part with Federal-aid funds, Federal law requires the bidder to make various certifications as a part of the proposal and contract. By execution and submission of the proposal, the bidder makes the certification contained therein. A false or fraudulent certification shall, in addition to all other remedies provided by law, be a breach of contract and may result in termination of the contract.

4. **AWARD CRITERIA AND REJECTION OF BIDS**. This contract will be awarded to the lowest responsive and responsible bidder considering conformity with the terms and conditions established by the Department in the rules, Invitation for Bids and contract documents. The issuance of plans and proposal forms for bidding based upon a prequalification rating shall not be the sole determinant of responsibility. The Department reserves the right to determine responsibility at the time of award, to reject any or all proposals, to readvertise the proposed improvement, and to waive technicalities.

By Order of the
Illinois Department of Transportation

Omer Osman,
Secretary

INDEX
FOR
SUPPLEMENTAL SPECIFICATIONS
AND RECURRING SPECIAL PROVISIONS

Adopted January 1, 2023

This index contains a listing of SUPPLEMENTAL SPECIFICATIONS and frequently used RECURRING SPECIAL PROVISIONS.

ERRATA Standard Specifications for Road and Bridge Construction (Adopted 1-1-22) (Revised 1-1-23)

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STATE OF ILLINOIS

SPECIAL PROVISIONS

The following Special Provisions supplement the "Standard Specifications for Road and Bridge Construction," adopted January 1, 2022, the latest edition of the "Manual on Uniform Traffic Control Devices for Streets and Highways," and the "Manual of Test Procedures for Materials" in effect on the date of invitation for bids, and the Supplemental Specifications and Recurring Special Provisions indicated on the Check Sheet included herein which apply to and govern the construction of FAU Route 9228 (25th Street), Section (Z-1)PS-2,29PS-2, St. Clair County, Contract No. 76P08, and in case of conflict with any part or parts of said Specifications, the said Special Provisions shall take precedence and shall govern.

FAU Route 9228 (25th Street)
Section (Z-1)PS-2,29PS-2
St. Clair County
Contract No. 76P08

LOCATION OF PROJECT

The project includes improvements at the 25th Street pump station location. The 25th Street pump station is in East St. Louis on the north side of St. Clair Avenue at the intersection with 25th Street (38º37'17"N, 90º7'26"W).

DESCRIPTION OF PROJECT

This project consists of the following:

- Constructing a new precast control building adjacent to the existing pump station building with the bathroom to include a water closet, lavatory, and shower.
- Install an electric instantaneous water heater to supply the lavatory and shower.
- Replace the existing generator and constructing a new generator pad.
- Provide new ventilation fans and an electric heater to condition the existing motor room.
- Provide new ventilation fans to the wet well.
- Install a heat pump heating and air conditioning unit to maintain space temperature control within the control room and bathroom.
- Provide a 4” water service to the building to allow for fire hose washdown and truck fill connections.
- Provide site security camera system with local recorder.
- Relocate highway lighting controls from exterior cabinet to within the pump control room. New power circuits will be on emergency generator.
- Relocate traffic control signal power circuit to pump control room. New power circuit will be on an emergency generator.
- Relocate existing pump controls from the motor room to the pump control room.

- Replace existing building lighting with LED fixtures.
- Replace all electrical devices within the existing building with items suitable for class 1 division 2 location.
- Installing a new closed circuit television dome camera on EB I-64 and running a fiber optic line to the new proposed pump station building.
- Modify the existing pump station building to address the 2017 Assessment Report prepared by Donohue and Associates.

SUBMITTAL OF EEO/LABOR DOCUMENTATION

Effective: April 2016

This work shall be done in accordance with Check Sheets No. 1, 3, and 5 of the IDOT Supplemental Specifications and Recurring Special Provisions and the Weekly DBE Trucking Reports (BDE) special provision, except as here-in modified.

PAYROLL AND STATEMENT OF COMPLIANCE:

Certified payroll (FORM SBE 48 OR AN APPROVED FACSIMILE) and the Statement of Compliance (FORM SBE 348) shall be submitted by two methods:

1. By Mail (United States Postal Service): The ORIGINAL of the certified payroll and the Statement of Compliance for the Prime Contractor and each Subcontractor shall be submitted by mail to the Regional Engineer for District 8.

2. Electronically: Scan both the ORIGINAL of the certified payroll and the Statement of Compliance to the same PDF file, and email to the District at the email address designated by the District EEO Officer.

SBE 48 and SBE 348 forms shall be submitted weekly and will be considered late if received after midnight seven business days after the payroll ending date.

WEEKLY DBE TRUCKING REPORT:

The Weekly DBE Trucking Report (FORM SBE 723) shall be submitted electronically. Scan the form to a PDF file, and email to the District at the email address designated by the District EEO Officer.

SBE 723 forms shall be submitted weekly and will be considered late if received after midnight ten business days following the reporting period.

MONTHLY LABOR SUMMARY & MONTHLY CONTRACT ACTIVITY REPORTS:

The Monthly Labor Summary Report (MLSR) shall be submitted by one of two methods:

1. For contractors having IDOT contracts valued in the aggregate at $250,000 or less, the report may be typed or clearly handwritten using Form D8 PI0148. Submit the ORIGINAL report by mail to the Regional Engineer for District Eight. Contractors also have the option of using the method #2 outlined below.

2. For contractors having IDOT contracts valued in the aggregate at more than $250,000, the report must be submitted in a specific "Fixed Length Comma Delimited ASCII Text File Format". This file shall be submitted by e-mail using specific file formatting criteria provided by the District EEO Officer. Contractors must submit a sample text file to District 8 for review at least 14 days prior to the start of construction.

The Monthly Contract Activity Report (MCAR) may be typed or clearly handwritten using Form D8 PI0149.

The MLSR and the MCAR shall be submitted concurrently. If the method of transmittal is method #1 above, then both the MLSR and the MCAR shall be mailed together in the same envelope. If the method of transmittal is method #2 above, then the MCAR shall be scanned to a .pdf file and attached to the email containing the MLSR .txt file.

The MLSR and MCAR must be submitted for each consecutive month, for the duration of the project, and will be considered late if received after midnight ten calendar days following the reporting period.

REQUEST FOR APPROVAL OF SUBCONTRACTOR:

The ORIGINAL and one copy of the Request for Approval of Subcontractor (FORM BC 260A) shall be submitted to the District at the IDOT Preconstruction Conference.

SUBSTANCE ABUSE PREVENTION PROGRAM CERTIFICATION:

The ORIGINAL and one copy of the Substance Abuse Prevention Program Certification (FORM BC 261) shall be submitted to the District at the IDOT Preconstruction Conference.

The Contractor is required to follow submittal procedures as provided by the EEO Officer at the preconstruction conference and to follow all revisions to those procedures as issued thereafter.

If a report is rejected, it is the contractor's responsibility to make required adjustments and/or corrections and resubmit the report. Reports not submitted and accepted within the established timeframes will be considered late.

Disclosure of this information is necessary to accomplish the statutory purpose as outlined under 23CFR part 230 and 41CFR part 60.4 and the Illinois Human Rights Act. Disclosure of this information is REQUIRED. **Failure to comply with this special provision may result in the withholding of payments to the Contractor and/or cancellation, termination, or suspension of the contract in whole or part.**

This special provision must be included in each subcontract agreement.

ALL HARD COPY FORMS TO BE SUBMITTED TO:

Region 5 Engineer
Illinois Department of Transportation
ATTN: EEO/LABOR OFFICE
1102 Eastport Plaza Drive
Collinsville, IL 62234-6198

Compliance with this special provision shall be included in the cost of the contract, and no additional compensation will be allowed for any costs incurred.

SITE SECURITY

All work shall be protected from damage by vandals, the weather, and other sources until final acceptance by the Department, such protection shall include temporary fencing or other barriers, if necessary, to restrict access to the work. Open pits, doors, hatches, etc. shall be covered, closed, and locked. No additional compensation will be granted, and no additional time will be allowed due to delays caused by failure to adequately protect the work from damage.

In addition, the Contractor shall make the worksite safe at the end of each workday, leaving no attractive nuisance hazards and no open electrical boxes and the like. All entrances, doors, and roof hatches at the pump station must be secured at the end of the day. The Department will not patrol the construction area. Anything inside temporary construction fence shall be Contractor's responsibility. Department authorized personnel will have access to the pump station at any time. The Contractor shall provide three extra keys for the Department's personnel.

DISTRICT 8 NON-MANDATORY PRE-BID

Any interested parties are encouraged to attend the non-mandatory, pre-bid walk-through that will begin on May 31, 2023 at 9 AM in East St. Louis, IL at the 25th Street pump station.

Each perspective bidder shall be allowed one representative to attend the tour. Each person is required to provide their own hard hat, safety shoes, eye protection, and OSHA Permit-Required Confined Spaces (29 CFR 1910.146) Training certification prior to beginning the tour. No photographs will be allowed during the tour of restrictive property.

Members from the Department will be present to facilitate the tour only. Inquiries regarding the contract plans and special provisions will be addressed per the bid invitation instructions.

START-UP AND FINAL ACCEPTANCE

Functional testing of equipment prior to pump station start-up:
After certification of proper installation by the manufacturer's representative, equipment shall undergo testing as outlined in the special provisions. In addition to this individual unit testing, the specific equipment system shall be tested in its entirety. This testing may disclose a punch list of issues which must be resolved before start-up can begin.

Performance testing during pump station start-up:
When the work at the pump station is complete, the Contractor shall begin start-up operations. During start-up, the complete storm water, collector well, and vertical well facilities shall be taken through various scenarios of operation, including normal starting/stopping of the pumps,

generator, ventilation systemss and emergency operation. This testing shall also be conducted during a simulated storm water event.

During this period, equipment performance shall be evaluated as well as individual system performance.

In addition, each system shall be tested to demonstrate its compatibility with interrelated systems. The overall operation of the entire station shall be evaluated, adjustments made, and settings recorded for inclusion in the Final Operation and Maintenance Data.

A punch list of operational problems, identified during this testing, shall be prepared and submitted to the Engineer for review. Problems with equipment, systems, and/or problems with the interaction between the various systems shall be rectified by the Contractor at no additional cost to the satisfaction of the Engineer. This testing shall be repeated until the Engineer determines satisfactory results have been obtained.

When the punch list of operating issues has been resolved, a 90-day period of continuous station operation shall begin. Upon completion of this period to the satisfaction of the Engineer, final acceptance of the facility shall be granted.

Item to be checked on start-up include, but not limited to, the following:

(a) Demonstration of pump control system
(b) Demonstration of transfer switch operation and maintenance
(c) Demonstration of generator system operation
(d) Check alarm operation SCADA system

The Contractor shall be prepared to demonstrate operation and maintenance procedures for all equipment installed.

STATUS OF UTILITIES TO BE ADJUSTED

NO UTILITIES TO BE ADJUSTED

The above represents the best information of the Department and is only included for the convenience of the bidder. The applicable provisions of Sections 102 and 103 and Articles 105.07 and 107.20 of the Standard Specifications for Road and Bridge Construction shall apply.

If any utility adjustment or removal has not been completed when required by the Contractor's operation, the Contractor should notify the Engineer in writing. A request for an extension of time will be considered to the extent the Contractor's operations were affected.

SUBMITTAL PROCEDURES

Submittals

Except as specified elsewhere herein, materials and equipment shall be in conformance with the requirements of Section 106 of the Standard Specifications. All iron and steel products which are incorporated into the work shall be domestically manufactured, produced, or fabricated. Contractor shall provide documents certifying domestic source. Also, all coating (epoxy, galvanizing, or painting) shall be domestically applied.

Materials and equipment shall be the products of established and reputable manufacturers and shall be suitable for the service required. Unless otherwise specifically indicated, all materials and equipment shall be new. The Contractor is obligated to conduct his or her own search into the timely availability of the specified equipment and materials to ensure that they are in strict conformance with the contract documents and that delivery schedules are compatible with project time constraints. Materials or equipment items which are similar or identical shall be the product of the same manufacturer. The cost of submittals, certifications, any required samples, and similar costs shall not be separately paid for but shall be included in the pay item bid price for the respective material or work.

All equipment, products, and materials incorporated in the work shall be submitted for approval.

Specific submittals required for individual elements of work are specified in the individual specification sections. Except as otherwise indicated, requirements specified herein shall be complied with for each indicated type of submittal. Procedures concerning items such as listing of manufacturers, suppliers, subcontractors, construction progress schedule, schedule of shop drawing submissions, bonds, payment applications, insurance certificates, and schedule of values are specified elsewhere.

Work-Related Submittals

Shop Drawings include technical data and drawings specially prepared for this project, including fabrication and installation drawings, diagrams, actual performance curves, data sheets, schedules, templates, patterns, reports, instructions, design mix formulas, measurements, and similar information not in standard printed form. Standard information prepared without specific reference to the project is not considered a shop drawing.

Product data includes standard printed information on manufactured products and systems that have not been specially prepared for this project, including manufacturer's product specifications and installation instructions, catalog cuts, standard wiring diagrams, printed performance curves, mill reports, and standard color charts.

Samples include both fabricated and manufactured physical examples of materials, products, and units of work; partial cuts of manufactured or fabricated work; swatches showing color, texture, and pattern; and units of work to be used for independent inspection and testing. Mock-ups are special forms of samples which are too large or otherwise inconvenient for handling in manner specified for transmittal of sample submittals.

Miscellaneous submittals are work-related submittals that do not fit in the previous categories, such as guarantees, warranties, certifications, experience records, maintenance agreements, operating and maintenance manuals, workmanship bonds, survey data and reports, physical work

records, quality testing and certifying reports, copies of industry standards, record drawings, and field measurement data.

Scheduling

A preliminary schedule of shop drawings and samples submittals shall be submitted for approval in duplicate.

Each submittal shall be prepared and transmitted to the Engineer sufficiently in advance of scheduled performance of related work and other applicable activities.

Within 60 days of the contract award, the Contractor shall submit for approval complete manufacturer's product data (for standard products and components) and detailed shop drawings (for fabricated equipment). Submittals need not include all project equipment and materials in one submittal. However, the submittals for the equipment and materials for each individual pay item shall be complete in every respect. Partial submittals may be returned without review. The Contractor may request, in writing, permission to make a partial submittal. The Engineer will evaluate the circumstances of the request and may accept to review such partial submittals. However, no additional compensation or extension of time will be allowed for extra costs or delays incurred due to partial or late submittals.

Each submittal shall be accompanied by a transmittal containing the following information: (four copies of each submittal are required)

(a) Contractor's name
(b) Supplier's name
(c) Manufacturer's name
(d) Date of submittal and dates of previous submittals containing the same material
(e) Project route/name
(f) Section
(g) Submittal and transmittal number
(h) Contract identification
(i) Identification of equipment and material with equipment identification numbers, motor numbers, and specification section number variations from contract documents and any limitations which may impact the work drawing sheet and detail number as appropriate
(j) Variations from contract documents and any limitations which may impact the work.
(k) Drawing sheet and detail number as appropriate.

Shop Drawings

Shop drawing information shall be newly prepared and submitted with graphic information at the accurate scale. The name of manufacturer or supplier shall be indicated. Dimensions shall be shown and clearly noted which are based on field measurements and materials and products shall be identified; and any revisions shall be identified. Compliance with standards and notation of coordination requirements with other work shall be indicated.

The following information shall be included on each drawing or page:

1) Submittal date and revision dates.
2) Project name, division number, and descriptions.
3) Detailed specifications section number and page number.
4) Identification of equipment, product, or material.

5) Name of contractor and subcontractor.
6) Name of supplier and manufacturer.
7) Relation to adjacent structure or material.
8) Field dimensions clearly identified.
9) Standards or industry specification references.
10) Identification of deviations from the contract documents.
11) Contractor's stamp, initialed or signed, dated, and certifying of review of submittal, certification of field measurements, and compliance with contract.
12) Physical location and location relative to other connected or attached material at which the equipment or materials are to be installed.

An 8-inch by 3-inch blank space shall be provided for Contractor and Engineer's stamps.

Three blue line or black line prints or two reverse sepia reproducible and 1 blue or black line print shall be submitted. One reproducible or one print will be returned.

Materials, products, or systems shall not be installed until a copy of applicable product data showing only approved information is in possession of Contractor. One set of product data (for each submittal) shall be maintained at jobsite. Four additional copies shall be marked with the date of approval and forwarded to the Engineer for use in field and for Department's O & M Manual and records.

Product Data

Required product data shall be collected into a single submittal for each element of work or system. Where product data has been printed to include information on several similar products that are not required for use on the project or are not included in submittal, copies shall be marked to clearly show such information is not applicable.

Where product data must be specially prepared for required products, materials, or systems because standard printed data is not suitable for use, data shall be submitted as a shop drawing and not as product data.

Submittal shall be final when returned by the Engineer and marked "Approved".

Three submittal copies, in addition to the number the Contractor requires, including those required for the Operation and Maintenance Manual shall be submitted to the Engineer.

Materials, products, or systems shall not be installed until copy of applicable product data showing only approval information is in possession of the Contractor. One set of product data (for each submittal) shall be maintained at jobsite, available for reference by the Engineer and others.

Samples

Where possible, samples shall be physically identical with proposed materials or products to be incorporated into the work. Where variations in color, pattern, or texture are inherent in material or product represented by the sample, multiple units (no less than 3 units) shall be submitted showing approximate limits of variations.

Each sample shall include a generic description, source or product name and manufacturer, limitations, and compliance with standards.

At the Contractor's option, and depending upon nature of anticipated response from Engineer, initial submittal of samples may be either preliminary or final submittal.

A preliminary submittal, consisting of a single set of samples, is required where specifications indicate Engineer's selection of color, pattern, texture, or similar characteristics from manufacturer's range of standard choices is necessary. Preliminary submittals will be reviewed and returned with Engineer's "Action" marking.

Three sets of samples shall be submitted in the final submittal, and one set will be returned. The returned final set of samples shall be maintained at jobsite in suitable condition for quality control comparisons throughout course of performing work. Returned samples intended or permitted to be incorporated in the work are indicated in specifications and shall be in undamaged condition at time of use.

Miscellaneous Submittals

Inspection and Test Reports: Each inspection and test report shall be classified as either "Shop Drawings" or "product data", depending on whether the report is specially prepared for the project or standard publication of workmanship control testing at point of production. Inspection and test reports shall be processed accordingly.

Guarantees, Warranties, Maintenance Agreements, and Workmanship Bonds: Submittal is final when returned by the Engineer and marked "Approved" or "Approved as Noted". In addition to copies desired for the Contractor's use, two executed copies shall be furnished. Two additional copies shall be provided where required for maintenance data.

Certifications: Seven copies shall be submitted. Certifications are submitted for review of conformance with specified requirements and information. Submittal shall be final when returned by the Engineer and marked "Approved".

Where certifications are specified, the information submitted for approval shall incorporate certification information. When a certification can be made prior to manufacture, the certification shall be included with initial submittal information. When certification is possible only after manufacture, the initial submittal information shall include a statement of intent to furnish the certification after equipment approval and manufacture. Certifications involving inspections and/or tests shall be complete with all test data presented in a neat, descriptive format with all test data, applicable dates, times, and persons responsible.

Tools: Spare parts, extra and overrun stock, maintenance tools and devices, keys, and similar physical units shall be submitted.

Special tools are considered to be those tools which, because of their limited use, are not normally available but which are necessary for maintenance of particular equipment.

A complete set of all special tools shall be furnished, including grease guns and other lubricating devices, which may be needed for the adjustment, operation, maintenance, and disassembly of such equipment. Tools shall be of high grade, smooth forged alloy tool steel. Grease guns shall be of the lever type.

One or more neat and substantial steel wall cases or cabinets shall be furnished and erected with flat key locks and clips or hooks to hold each special tool in a convenient arrangement.

Contractor's Stamp: Prior to submittal, the Contractor shall review the submittal material and shall affix his or her stamp of approval, with comments as applicable, signed by a responsible representative to each appropriate submittal item. In the case of subcontractor's submittals, both the Sub- contractor and the Contractor shall review and stamp the submittal. Submittals which are not approved or approved-as-noted by the Contractor shall not be submitted to the Engineer. The Contractor shall not give an approved-as-noted status to submittals having incompleteness or major corrective notations as this will only delay the ultimate approval process.

The receipt of submittal information from the Contractor will be construed as the Contractor's assurance that he or she has reviewed the submittal information and attests to the submittal's accuracy and conformance to the requirements of the contract documents. Submitted information shall be complete and in sufficient detail to demonstrate compliance with all requirements of the contract documents, including fitting in the space provided and meeting all salient features of the specifications.

Submittal information must be particularly detailed in every respect. Product data shall present information to demonstrate the complete nature of the product, including dimensions, wiring diagrams, operating information, and the like. Shop drawings shall be extremely detailed and shall include all appropriate dimensions, fabrication details, component bill of material, information relative to mounting, detailed wiring, finish, and the like. Wiring diagrams shall include both schematic and point-to-point representations, complete with references to circuiting as indicated on the plans as well as terminal points of component devices.

Unless required elsewhere, submittals shall be distributed to subcontractors, suppliers, governing authorities, and others as necessary for proper performance of work.

Except for submittals for records and similar purposes and where action and return on submittals are required or requested, the Engineer will review each submittal, mark with appropriate action, and return. Where the submittal must be held for coordination, the Engineer will also advise the Contractor without delay. The Engineer will stamp each submittal with a uniform, self-explanatory action stamp appropriately marked with submittal action.

Where submittals are marked "Reviewed", work covered by the submittal may proceed **provided it complies with the contract.** Acceptance of work will depend upon that compliance.

When submittals are marked "Reviewed as Noted" or "Reviewed Subject to Corrections Marked", work covered by the submittal may proceed **provided it complies with both Engineer's notations or corrections on the submittal and with the contract**. Acceptance of work will depend on that compliance. Resubmittal is not required.

When submittals are marked "Examined and Returned for Correction or Disapproved", work covered by the submittal shall not proceed and shall not be used at the jobsite or elsewhere where work is in progress. The submittal shall be revised or a new submittal shall be prepared in accordance with the Engineer’s notations in accordance with the resubmittal preparation procedures. The submittal shall be resubmitted without delay and repeated if necessary to obtain different action marking.

Any need for more than one resubmission or any other delay in the Engineer’s review of submittals will not entitle the Contractor to an extension time.

Coordination: Preparation and processing of submittals shall be coordinated with performance of the work, other submittals, and related activities such as substitution requests, testing, purchasing, fabrication, delivery, and similar activities that require sequential activity.

Submission of different units of interrelated work shall be coordinated so that one submittal will not be delayed by the Engineer's need to review a related submittal. The Engineer may withhold action on any submittal requiring coordination with other submittals until related submittals are forthcoming.

Unless otherwise indicated, guarantees as specified herein shall be included with the submittal information of all applicable equipment and materials. Incompleteness, inaccuracy, or lack of coordination shall be grounds for rejection. The Contractor shall clearly understand no equipment or material shall be installed prior to approval and that any equipment or material installed prior to approval is subject to removal from the right-of-way solely at the Contractor's expense.

Resubmittal Preparation: Resubmittal preparation shall comply with the requirements described in this special provision. In addition, it shall be identified on the transmittal form that the submittal is a resubmission.

Any corrections or changes in submittals required by the Engineer's notations shall be made on the returned submittal.

On the transmittal or on a separate page attached to the Contractor's resubmission transmittal, all notations or questions indicated by the Engineer shall be answered or acknowledged in writing. Each response shall be identified by a notation number established by the Engineer. If the Contractor does not respond to each notation, the resubmission will be returned without action by the Engineer until the Contractor provides a written response to all notations or questions.

Variations or revisions from a previously reviewed submittal, other than those called for by the Engineer, shall be identified on transmittal form.

QUALITY CONTROL

Submittals

Authoritative evidence in the form of Certificates of Manufacture shall be furnished to the Engineer to show that the materials and equipment to be used in the work have been manufactured and tested in conformity with the contract. Copies of the results of physical tests that have been made directly on the product or on similar products of the manufacturer shall be included where necessary.

If at any time prior to the expiration of any applicable warranties or guarantees, equipment is rejected by the State, then all sums of money received for the rejected equipment shall be repaid to the State. Upon the receipt of the sum of money, the State will execute and deliver a bill of sale of all its rights, title, and interest in and to the rejected equipment. The equipment shall not be removed from the premises of the State until the State obtains, from other sources, equipment to take the place of that which is rejected. The State hereby agrees to obtain other equipment within a reasonable time and the Contractor agrees that the State may use the equipment furnished by the Contractor without rental or other charges until the other new equipment is obtained.

Notice shall be given in writing to the Engineer sufficiently in advance of the commencement of manufacture or preparation of materials especially manufactured or prepared for use in or as part of the permanent construction. When required, notice shall include a request for inspection, the date of commencement, and the expected date of completion of the manufacture or preparation of materials. Upon receipt of such notice, Engineer will arrange to have a representative present at such times during the manufacture or testing as may be necessary to inspect the materials, will notify Contractor that the inspection will be made at a point other than the point of manufacture or testing, or that the inspection will be waived. These provisions shall be complied with before shipping any materials. Such inspection will not constitute a release from the responsibility for furnishing materials meeting the requirements of the contract.

Tests of electrical and mechanical equipment and appliances shall be conducted in accordance with recognized test codes of the ANSI, ASME, or IEEE, except as may otherwise be stated herein.

Personnel shall be provided to assist the Engineer in performing the following periodic observation and associated services.

(a) Soils: Observe and test excavations, placement, and compaction of soils. Determine suitability of excavated material. Observe subgrade soils and foundations.

(b) Concrete: Observe forms and reinforcement; observe concrete placement; witness air entrainment tests, facilitate concrete cylinder preparation, and assist with other tests performed by the Engineer.

(c) Masonry: Sample and test mortar, bricks, blocks and grout; inspect brick and block samples and sample panels; and inspect placement of reinforcement and grouting.

When specified in the contract, an independent laboratory testing facility shall be provided to perform required testing. The laboratory shall be qualified as having performed previous satisfactory work. Prior to use, such qualifications shall be submitted to the Engineer for approval.

At least 24 hours' notice shall be given prior to when specified testing is required. Labor, materials, and necessary facilities shall be provided by the Contractor at the site as required by the Engineer and the testing laboratory.

Equipment test procedures shall be coordinated and demonstrated as specified in the contract or as otherwise required during the formal tests.

Test procedures and requirements for pipelines and other testing shall conform to the specificiations.

Where transcripts or certified test reports are required by the contract, the following requirements shall be met. For all required transcripts, certified test reports, certified copies of the reports of all tests required in the contract, the Contractor shall submit and obtain approval of the Engineer before delivery of materials or equipment. All testing shall be performed in an approved independent laboratory or the manufacturer's laboratory. Reports of shop equipment tests shall be submitted for approval within 30 days of testing. Transcripts or test reports are to be accompanied by a notarized certificate in the form of a letter from the manufacturer or supplier certifying that tested material or equipment meets the specified requirements and the same type,

quality, manufacture and make as specified. The certificate shall be signed by an officer of the manufacturer or the manufacturer's plant manager.

As approved by the Engineer, a notarized Certificate of Compliance shall be submitted for approval. The certificates may be in the form of a letter stating the following:

(a) Manufacturer has performed all required tests.
(b) Materials to be supplied meet all test requirements.
(c) Tests were performed not more than one year prior to submittal of the certificate.
(d) Materials and equipment subjected to the tests are of the same quality, manufacture, and make as those specified.
(e) Identification of the materials.

Initial inspection and testing of materials furnished under this contract will be performed by Department or its representatives without cost to the Contractor. However, if the test required is beyond the Department's capability, the test shall be conducted by a department approved testing service and paid for by the Contractor. If subsequent testing is necessary due to failure of the initial tests or because of rejection for noncompliance, the tests shall be conducted by a department approved testing service and paid for by the Contractor.

Materials and equipment submitted by the Contractor as the equivalent to those specifically named in the contract may be tested by the Department or by an approved testing service for compliance.

The Department shall be reimbursed for all costs associated with witness tests which exceed five calendar days per kind of equipment.

As soon as conditions permit, all labor, materials, and services for preliminary field tests of all equipment shall be furnished as provided under this contract. If the preliminary field tests disclose that any equipment furnished and installed under this contract does not meet the requirements, all changes, adjustments, and replacements required shall be made prior to the acceptance tests.

Upon completion of the work and prior to final payment, all equipment, piping, and appliances installed under this contract shall be subjected to acceptance tests to demonstrate compliance.

All labor, fuel, energy, water and other materials, equipment, instruments and services necessary for all acceptance tests shall be furnished by the Contractor.

Field tests shall be conducted in the presence of the Engineer. The field tests shall demonstrate that under all conditions of operation each equipment item:

(a) Has not been damaged by transportation or installation
(b) Has been properly installed
(c) Has no mechanical defects
(d) Is in proper alignment
(e) Has been properly connected
(f) Is free of overheating of any parts
(g) Is free of all objectionable vibration
(h) Is free of overloading of any parts
(i) Operates as intended

Work or portions of work shall be operated for a minimum of 100 hours or 14 days continuous service, whichever comes first. Test on those systems which require load produced by weather (heating or cooling) exercise shall be conducted only when weather will produce proper load.

If the acceptance tests reveal defects in material or equipment or if the material or equipment in any way fails to comply with the requirements of the contract, such deficiencies shall be promptly corrected. Failure or refusal to correct the deficiencies or if the improved materials or equipment when tested again fail to meet the guarantees or specified requirements, the Department, notwithstanding its partial payment for work and materials or equipment, may reject said materials or equipment and may order the Contractor to remove the defective work from the site at no additional and replace it with material or equipment which meets the requirements.

If it is ascertained by testing or inspection that the material or equipment does not comply with the Contract, the material or equipment shall not be delivered. If it is delivered then it shall be promptly removed from the site and replaced with acceptable material without additional cost to Department.

A final inspection and field testing of all work completed and equipment furnished shall be required before acceptance. This final field testing must include an operational demonstration to verify complete compliance with all contract requirements. This inspection and testing must be requested a minimum of seven calendar days prior to the proposed date. Final field testing shall be conducted over consecutive calendar days. A record of the initial performance of the equipment shall be kept for placement in the Operation and Maintenance Data. Four copies of completed record drawings for the pump station shall be submitted after the final field testing. The field testing shall comply with all requirements as outlined in the Department's Drainage Manual.

WARRANTIES

All equipment shall be furnished complete with the manufacturer's guarantee/warranty or any warranty specified in the special provisions from the date of final acceptance. Such guarantees shall accompany submittal shop drawings and product data.

Prior to final payment, the original and one copy of all bonds, warranties, guarantees, and similar documents, including those customarily provided by manufacturers and suppliers which cover a period greater than the one year correction period, shall be delivered to the Department.

PROJECT RECORD DOCUMENTS

One record copy of all contract documents, reference documents, and all technical documents submitted in good order shall be kept and maintained at the site. On mylar tracing media and using drafting symbols and standards consistent with the original documents, as builts shall be annotated in red to show all changes made during the construction period. Annotated drawings are to be made available to Engineer for reference at all times.

At completion of the contract and before final payment is made, one set of clearly readable, reproducible mylar as builts reflecting all changes made during construction shall be delivered to the Engineer. The drawings shall each be stamped "RECORD DRAWING" and shall be marked with the Contractor's stamp, the date, and the signature of the Contractor.

Four copies of completed record drawings for the pump station must be submitted and must be acceptable to the Engineer prior to final acceptance.

This work will not be measured for payment.

CONFINED SPACE ENTRY

The area below the motor room floor slab on the existing 25th Street pump station is a confined space. The Contractor shall comply with all OSHA requirements relative to confined space entry. An oxygen deficient, toxic, explosive, or flammable atmosphere may exist within this confined space. Atmosphere testing shall be conducted prior to entry and continuously while employees are working within a confined space. The Contractor shall inform the Engineer of who will serve as the rescue responder in an emergency and what system will be used to notify the responder that an emergency exists. Compliance with this provision shall be considered included to the contract, and no additional compensation will be allowed.

CLEANING SUMP

Work consists of cleaning the sump area of the existing pump station. Material to be removed during the cleaning process consists of silt, sand, and various roadside litter. Removed material shall be disposed of by the Contractor in such a manner that public or private property will not be damaged or endangered according to Article 202.03 and in accordance with any applicable laws and regulations. Stockpiling removed material on state right of way will not be permitted.

The District Bureau of Operations will pump the water level down using the permanent storm water pumps until they break suction. Any additional dewatering necessary will be the Contractor’s responsibility. The Contractor will not be permitted to operate the permanent storm water pumps. Excess liquid removed during the cleaning process may be released into the discharge areas.

In the event the ground water level rises to an unacceptable level, the Contractor must suspend work activities at the site until the level can be lowered. Some ground water infiltration should be expected through the storm water drainage system at all sides. The Contractor shall evaluate this

ground water infiltration prior to bidding. The Contractor must be prepared to stop work and evacuate the sump area immediately in the event of storm water inflow.

Appropriate care shall be taken by the Contractor to prevent damage of level sensing equipment during the cleaning process. Any damage to this equipment caused by the Contractor shall be repaired by the Contractor at his or her expense.

The designated areas shall be considered clean when no more than ½" inch of solids or semi-solids remain at any spot. Bidders are responsible for inspecting the existing conditions to determine the necessary work.

Basis of Payment. Payment will be made at the contract unit price per LUMP SUM for CLEAN SUMP, of the location specified.

SALVAGED MATERIALS

All existing equipment shall be salvaged and remain the property of the State of Illinois as noted in the plans and specified herein. Equipment shall be delivered to the Bowman Avenue pump station at 728 Exchange Avenue, East St. Louis, IL. The salvaged equipment shall be secured on pallets prior to delivery to the pump station. The Contractor shall contact Pete Sawyer at 618-346-3275 to arrange the delivery.

Items of note to be salvaged and remain the property of the State of Illinois:

- Existing Exterior Generator

The cost of this work will be included in the contract LUMP SUM price for PUMP STATION GENERAL WORK**.**

TRAFFIC CONTROL PLAN

Traffic control shall be according to the applicable sections of the Standard Specifications, the Supplemental Specifications, the Illinois Manual on Uniform Traffic Control Devices for Streets and Highways, any special details and highway standards contained in the plans, and the special provisions contained herein.

Special attention is called to Article 107.09 and 107.14 of the Standard Specifications and the following highway standards, details, Quality Standard for Work Zone Traffic Control Devices, Recurring Special Provisions, and special provisions contained herein relating to traffic control.

The Contractor shall contact the District Eight Bureau of Traffic at least 72 hours in advance of beginning work.

Standards:

701101	701106	701400	701406	701411	701601
701701	701801	701901			

Signs:

No bracing shall be allowed on post-mounted signs. Post-mounted signs shall be installed using Standards 720011, 728001, and 729001; on 4"x4" wood posts; or on any other "break away" connection approved by the Engineer.

All signs are required on both sides of the road when the median is greater than 10 feet and on one way roadways.

All conflicting existing roadway signs shall be covered during the maintenance of traffic staging. When covering existing department signs, no tape shall be used on the reflective portion of the sign.

Devices:

A minimum of three drums spaced at 4 feet shall be placed at each return when the side road is open.

Direction indicator barricades shall exclusively be used in lane closure tapers. They shall be used only when traffic is being merged with an adjacent through lane.

Lights:

Steady burn mono-directional lights are required on devices delineating a widening trench.

Maintenance of Traffic:

The Contractor shall be required to notify the corresponding emergency response agencies, school bus companies, and the Department of Transportation (Bureau of Project Implementation) regarding any changes in traffic control.

The Contractor shall be required to notify the City of East St. Louis for any side road closure or opening.

In addition to field reviews, plan dimensions and details relative to the existing facilities have been taken from existing plans and are subject to construction variations. It shall be the Contractor's responsibility to verify such dimensions and details in the field. Such variations shall not be a cause for additional compensation due to a change in the scope of work. The Contractor will be paid for the quantity actually furnished at the unit price bid for the work.

Channelizing Cones:

The channelizing cones shall conform to NCHRP-350 Report and Federal MUTCD standards for nighttime use. The height of the sheeting shall be 42" above the roadway.

The channelizing cone body shall be made from an impact resistant, flexible, and reboundable material that is highway orange meeting federal color standards. The material shall be specifically formulated with ultraviolet stabilizers to provide satisfactory weatherability characteristics and resist fading.

The channelizing cone shall have a minimum of two orange 6 inch bands of reflective sheeting and two white 6 inch bands of reflective sheeting. The first (top) and third bands shall be orange, and the second and fourth (bottom) bands shall be white. The retroreflective sheeting for the bands shall meet the requirements of Article 1106.02 of the Standard Specifications. Nonreflective spaces between the bands shall be no wider than 2 inches.

The channelizing cone, when properly ballasted, is not to move, overturn, or separate due to air turbulence created by passing vehicles or moderate winds. The ballast is to be supplied by the manufacturer, is to weigh no less than 30 pounds, and is not to present a hazard to motorists, workers, or pedestrians. The channelizing cones shall have an anti-roll feature that prevents the cones from rolling freely if overturned.

WORK DURING PEAK HOURS

The Contractor shall have at least two lanes of traffic open on FAI Route 64 during peak hours in each direction. The Contractor will not be allowed to conduct any type of operation in the open lanes or any type of operation that would impede the flow of traffic during peak hours. Peak hours are defined as 6:00 am to 9:00 am for the westbound traffic and 3:00 pm to 6:00 pm for the eastbound traffic.

FAILURE TO OPEN TRAFFIC LANES TO TRAFFIC FOR PEAK PERIODS

The Contractor is required to open the road to traffic at certain specified times described in these special provisions. Should the Contractor fail to completely open and keep open the lanes to traffic, as described elsewhere in these special provisions, he or she shall be liable to the Department in the amount of $1,000.00 for each and every 15-minute interval, or portion thereof, that a lane is blocked outside the allowable time limitations. No provisions of this clause shall be construed as a penalty but as liquidated and ascertained damages. Such damages may be deducted by the Department from any moneys due the Contractor. These damages shall apply during the contract time and during any extensions of the contract time.

TRAFFIC CONTROL AND PROTECTION, STANDARD 701411

This standard will be measure and paid for per each location, no matter the number of set-ups.

CHANGEABLE MESSAGE SIGNS

This work consists of furnishing, placing, and maintaining changeable message signs according to the Standard Specifications and the following:

All signs must be in place and operational for a minimum of seven calendar days prior to beginning of the work and subsequent traffic stages. Each sign shall state the day work will begin and delays are possible. The exact message will be approved by the Engineer. The Contractor may be required to relocate each sign multiple times during the contract at his or her expense. The exact location of the placement of these signs shall be determined in the field by the Engineer.

Four changeable message signs shall be located at locations designated by the Engineer.

Method of Measurement. Changeable message signs will be measured for payment in calendar months.

Basis of Payment. This work will be paid for at the contract unit price per CALENDAR DAY for CHANGEABLE MESSAGE SIGN.

CONCRETE REMOVAL

This work shall consist of all work required to sawcut, dispose, and remove the existing concrete slab of the existing pump station building motor room floor in accordance with the design plans or as determined by the Engineer.

Method of Measurement. Concrete Removal will be measured for payment in cubic yards for the existing slab being removed.

Basis of Payment. This work will be paid for at the contract unit price per CUBIC YARD for CONCRETE REMOVAL.

FENCE REMOVAL

This work shall consist of all work required to disassemble, dispose, and remove the existing chain link fence, gates, posts, and hardware around the existing pump station building as shown on the design plans or as determined by the Engineer.

Method of Measurement. Fence removal will be measured for payment per foot of existing fence being removed.

Basis of Payment. This work will be paid for at the contract unit price per FOOT for FENCE REMOVAL.

CHAIN LINK FENCE, 8' (SPECIAL) AND CHAIN LINK GATES (SPECIAL)

This work shall consist of furnishing, erecting, and installing chain link fence, gates, and accessories in accordance with Section 664 of the Standard Specifications, at locations shown in the plans, and as directed by the Engineer.

The chain link fence and gates shall have three strands of barbed wire across the top of the fence.

Height of the fence and gates shall be measured to the top of the chain link fabric.

Type of gate is shown on the plans. Gate shall be a 24' double gate.

Method of Measurement. Chain link fence (special) will be measured for payment in feet along the top of the fence from center to center of end posts, excluding the length occupied by gates.

No additional compensation shall be given to the Contractor, if the size or depth of the fence post excavation exceeds the dimensions in the plans or highway standard.

Removal of pavement, curb and gutter, or other roadway improvements that interfere with the construction of the fence as shown in the plans and standards shall not be measured for payment but will be included in the costs of the fence or gates.

Basis of Payment: This work will be paid for at the contract unit price per FOOT for CHAIN LINK FENCE, (SPECIAL), of the height specified and at the contract unit price per EACH for CHAIN LINK GATES (SPECIAL).

TREE, TAXODIUM DISTICHUM (COMMON BALD CYPRESS), 4" CALIPER, BALLED AND BURLAPPED

This work shall consist of furnishing and planting fifteen **15** trees at two separate sites.

- Site 1: 25th Street pump station located in East St. Louis on the north side of St. Clair Avenue at the intersection with 25th Street (38º37'17"N, 90º7'26"W).

- Site 2: Selected IDOT right-of-way located approximately 6 miles east of 25th Street on the south side of I-64 and north side of Holy Cross Road, where Holy Cross Road curves (38º36'13"N, 90º1'22"W).

Five trees will be planted at Location 1 (onsite) and ten trees will be planted at location 2 (off-site). Verify location of trees with District prior to planting.

WATER VALVES

Description. This work shall consist of furnishing and installing water valves in accordance with the Section 561 of the Standard Specifications for Water and Sewer Main Construction in Illinois, the Illinois American Water company standards, and as shown in the plans. In case of conflict, the stricter standard shall apply.

Provide valves with clockwise closing direction.

Gate valves:

1. Valves 4-inch to 12-inch size:
   a. Design in accordance with AWWA C509 (cast iron body) or AWWA C515 (ductile iron body) bronze fitted, modified wedge disc, and resilient wedge and seat type with non-rising stem and O-ring packing.

2. Provide mechanical joint ends and a cutting-in sleeve or similar sliding/make-up piece for valves installed in vaults as indicated on the plans.

3. Acceptable valve manufacturers are Mueller No. A-2370-20 or approved equal.

Butterfly valves:

1. Valves greater than 12-inch size:
2. Design in accordance with AWWA C504 for pressure Class 150B, cast iron body, rubber-seated, and tight closing type suitable for buried service.
3. Provide mechanical joint ends and a cutting-in sleeve or similar sliding/make-up piece for valves installed in vaults.
   a. Provide restrained type joints for all mechanical joint end valves.
4. Use valve shaft of either 18-8 or Type 304 stainless steel. Extend valve shaft through the valve disc and body into the operator.
5. Provide each valve with a fully enclosed, sealed, grease-packed integral geared manual operator with a 2-inch square operating nut.
6. Acceptable butterfly valve manufacturers are Mueller Lineseal III or approved equal.

Basis of Payment. This work will be paid for at the contract unit price per EACH for WATER VALVES of the diameter specified.

DOMESTIC METER VAULTS

This item includes furnishing all labor and materials necessary to furnish and install a water meter, all piping with required fittings, and concrete vault in accordance with the Standard Specifications for Water and Sewer Main Construction in Illinois, the Illinois American Water Company standards, and as shown in the plans. In case of conflict, the stricter standard shall apply.

Materials. Materials for the concrete meter vault shall be in accordance with Section 602 of the Standard Specifications for Road and Bridge Construction.

Covers shall open to 90 degrees and lock automatically in that position. A handle shall be provided to release the cover for closing.

Method of Measurement. All piping, fittings, and meters within the inside face of the domestic meter vault will not be measured for payment.

Basis of Payment. This work will be paid for at the contract unit price per EACH for DOMESTIC METER VAULTS.

STEEL CASING PIPE, BORED AND JACKED, 8"

Description. The work shall consist of steel casing pipe complete in place by boring, including providing both jacking and receiving pits and tight sheeting to protect adjacent utilities, roadways and property or to provide protection to the public; protection; repair or replacement of utilities; traffic control; fencing of work site to provide protection to public; excavation; removal and disposal of waste excavated materials; bracing; dewatering, including erosion and sedimentation control methods and devices to provide protection to environment from all pumping operations; providing and jacking or ramming of casing pipe; grouting of voids between casing and casing excavation; installing carrier pipe; supporting carrier pipe within the casing with casing spacers; end seals; testing; backfilling with compacted granular backfill; cleanup; and finish grading.

Provide new steel casing pipe conforming to ASTM A139 Grade A with continuous field-welded butt joints in accordance with AWWA C206, with minimum yield strength of 35,000 psi, and with the following minimum wall thickness of 0.375” for a 36” diameter casing.

Removal and replacement of casing to avoid obstructions and to achieve correct slope, elevation, and bearing will be done at no additional cost. Installation of short lengths of casing and carrier pipe because of limited working room will be done at no additional cost.

Casing spacers shall consist of molded high density polyethylene, 304 stainless-steel, or 14 gauge (minimum) hot rolled and pickled steel; a minimum 10 mil of fusion bonded PVC coating on the steel bands; and a minimum 0.090-inch PVC liner on the steel bands. Bolts, washers, and nuts shall be 304 stainless-steel. Runners shall be glass reinforced or glass filled high density reinforced plastic. The casing spacers shall be restrained in all directions with one spacer on each side of and a maximum of 12 inches from each joint and a minimum of one spacer between the joints with additional spacers as recommended by casing spacer manufacturer. The acceptable products are PSI, Advance, Cascade, or an approved equal.

End seals shall be rubber end seals made specifically for the purpose of sealing around carrier pipes and the outside of the steel casing pipes.

Casing void pressure grout to fill voids outside the casing pipe shall consist of a clean dry concrete mix, composed of one part Portland cement and 10 parts of sand and gravel by volume or another mix approved by the Engineer. Alternatively, the Contractor may use a low density cellular concrete grout with a minimum net density of 45 pounds per cubic foot with a minimum compressive strength of 160 pounds per square inch at 28 days. Acceptable products for low density grout are Mearl Geofoam Liquid Concentrate or an approved equal.

Provide and install a 17-pound magnesium type anode at each end of the casing with welded connections between the anode lead and the casing pipe.

Method of Measurement. The work will be measured in lineal feet for the length of the casing pipe.

Basis of Payment. The work will be paid for at the contract unit price per FOOT for STEEL CASING PIPE, BORED AND JACKED, 8".

The work does not include the 4" water service line, which will be paid for as WATER SERVICE LINE 4**"**. The work does not include the 4" sanitary sewer line, which will be paid for as SANITARY SEWER LINE 4".

SANITARY SEWER 4"

This item includes furnishing all labor and materials necessary to furnish and install sanitary sewer in accordance with the Standard Specifications for Water and Sewer Main Construction in Illinois and the Metro East Sanitary District standards. In case of conflict, the stricter standard shall apply. Sanitary sewer pipe shall be PVC DR-35 conforming to ASTM D3034.

Method of Measurement. Measurement for this work will be per foot as measured from the new pump station building to the connection to the existing sewer main.

Basis of Payment. This work will be paid for at the contract unit price per FOOT for SANITARY SEWER 4".

SANITARY SEWER CONNECTION

This item includes furnishing all labor and materials necessary to connect the proposed 4" sanitary sewer from the new building to the existing sanitary sewer system. This work shall conform to the Standard Specifications for Water and Sewer Main Construction in Illinois and the Metro East Sanitary District standards. In case of conflict, the stricter standard shall apply.

Basis of Payment: This work will be paid for at the contract unit price per EACH for SANITARY SEWER CONNECTION.

MANHOLES, SANITARY, 5'-DIAMETER, TYPE 1 FRAME, CLOSED LID

Description. This work shall consist of furnishing and installing sanitary manholes of the size indicated on the plans with the required frame and grate in accordance with Sections 602 of the Standard Specifications for Road & Bridge Construction and Section 32 of the Standard Specifications for Water & Sewer Construction in Illinois, except as modified herein.

General Requirements: Sanitary manholes shall be constructed using precast reinforced concrete sections in accordance with Article 602.07, except that joints between precast sections and pipe to manhole connections shall include watertight flexible gaskets or rubber gaskets. Preformed flexible gaskets shall conform to the requirements of ASTM C 990. Rubber gaskets shall conform to the requirements of ASTM C 443. Pipe to manhole connections shall conform to the requirements of ASTM C 923.

Trenches resulting from the installation of sanitary manholes shall be backfilled according to the applicable requirements of Article 602.12.

Method of Measurement. Construction of sanitary manholes shall be measured for payment as an each item.

Basis of Payment. This work will be paid for at the contract unit price per EACH for MANHOLES, SANITARY, 5'-DIAMETER, TYPE 1 FRAME, CLOSED LID, which price includes all labor, material, and equipment necessary to complete the work specified herein. Preformed flexible gaskets or rubber gaskets used at the joints between precast sections will also be included in the unit cost of this item.

SAW CUTS

Saw cuts required for removal items shall not be paid for separately. The cost of the saw cuts will be included in the respective removal pay item.

PUMP STATION MECHANICAL WORK

COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Piping materials and installation instructions common to most piping systems.
   2. Dielectric fittings.
   3. Mechanical sleeve seals.
   4. Sleeves.
   5. Escutcheons.
   6. Grout.
   7. Equipment installation requirements common to equipment sections.
   8. Supports and anchorages.
   9. All removal items associated with Mechanical Equipment.

1.2 SUBMITTALS

A. Shop Drawings – Prior to purchase, submit for Engineer's review complete shop drawings for the following:
   1. Plumbing fixtures and specialties.

B. Welding Certificates.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than plumbing and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, and spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and plumbing equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.4 QUALITY ASSURANCE

A. Standards: Any procedure, material or operation specified by reference to applicable standards or codes shall comply with the current or most recent edition. In conflicts between listed standards, the more stringent shall govern.
   1. Applicable Standards:
      a. Illinois State Plumbing Code, latest edition
      b. Local plumbing code
      c. National Fuel Gas Code, latest edition

B. Contractor shall obtain all necessary permits and arrange for all inspections required by State or Local authorities.

C. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

D. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
   1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
   2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

E. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

F. Materials must be new, in first class condition. Work must be done by trained, experienced, skilled journeyman (woman) under an approved full time supervisor, with every possible precaution taken by contractor to assure safety of all persons of all categories.

1.5 GUARANTEE

A. Each entire overall installation, including every special item, device, and part and every specialized system shall be fully guaranteed from standpoint of satisfactory performance, safety, workmanship and material for one year after formal written acceptance by Engineer, any unsuitable, unsatisfactory, noisy, ineffective, defective, improperly sized or applied equipment or material, or unacceptable workmanship shall be quickly replaced or modified during guarantee period or any extension thereof, as directed and as approved by Engineer in writing.

B. Individual items and systems shall be guaranteed for the same period in addition to the above regardless of any limitations of manufacturer’s guarantee period.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

A. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

B. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

D. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.

E. Welding Filler Metals: Comply with AWS D10.12.

F. Solvent Cements for Joining Plastic Piping:
1. ABS Piping: ASTM D 2235.
2. CPVC Piping: ASTM F 493.
3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
4. PVC to ABS Piping Transition: ASTM D 3138.

2.3 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.4 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

B. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

C. Pressure Plates: Carbon steel. Include two for each sealing element.

D. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.5 SLEEVES

A. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

B. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. 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.

D. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.

E. PVC Pipe: ASTM D 1785, Schedule 40.

F. Molded PE: Reusable, PE, tapered-cup shaped and smooth-outer surface with nailing flange for attaching to wooden forms.

2.6 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.
1. Finish: Polished chrome-plated and rough brass.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
1. Finish: Polished chrome-plated and rough brass.

2.7 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 PREPARATION

A. Quantities Required and Clarifications:
1. Contractor shall determine quantities required from drawings and job conditions except that where specifications call for specific quantities, these quantities shall also govern. If there if conflict between quantities called for on drawings and in specifications, greater quantity shall govern.
2. Where an item is specified by a manufacturer's number, such number is for general information only, and shall be modified by any additional data, size, etc., which may be shown and/or specified. Where there is conflict between number and other data, it shall be contractor's responsibility to request clarification from Engineer.
3. Where clarification is required for any purpose, including discrepancies within written specifications on drawings, or between them, it shall be contractor's responsibility to request such clarification from Engineer at least 7 days before Bids are due and in all cases subsequent interpretations or clarifications made by Engineer shall be final.

B. Identification:
1. Every piece of equipment, disconnect, etc. which does not have and identifying name plate shall be stenciled to identify its use, by means of the abbreviations used in these specifications. Stencil shall be painted in approved colors, with letters at least ¼" high. Stencil shall be located as approved by the Engineer. At contractor's option, tags may be riveted or screwed to equipment, in place of stencils.

C. Cleaning:
1. Piping, conduit, equipment, devices, etc. shall be thoroughly cleaned before being offered for acceptance.
2. The following shall be thoroughly cleaned, or finished out, or blown out before installation is offered for acceptance.
Plumbing equipment, fixtures, devices, etc.
3. Labels, stickers, temporary protection, etc. shall be removed and work shall be provided contractor without increase in contract price.

D. Permits, Fees, Enlargements, Extensions, Etc.:
1. Contractor shall secure and pay for all licenses, assessments, permits; shall pay for inspections required by county, state, and local utilities; and shall replace new or present paving etc. as approved by Engineer and all governmental bodies having jurisdiction. All without increase in contract price.

E. Verification of Points of Connection:
1. Before submitting his bid, contractor shall visit site to verify all exposed, concealed, and buried points of connection as to locations, flow, size, type, depth, pressure, elevation, operating characteristics, etc., including but not limited to the following:

a. Water service and shut-offs.
b. Sanitary sewer connections.
c. Storm sewer connections.

2. If contractor finds that any present point or points of connection to existing facilities are incorrectly shown on plans or incorrectly specified, he (she) shall notify Engineer in writing at least 7 days before bids are due to be submitted. Engineer will issue as addendum to all contractors, calling their attention to revised point or points of connection.
3. If contractor fails to notify Engineer in writing as outlined above, it will be assumed that his bid includes everything required to provide proper connections to all present points of connections as they actually exist and will pay for all relocations, replacements, additional runs and extensions, without increase in contract price.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

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. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for exposed penetrations of walls, ceilings, and floors.

M. Install sleeves for pipes passing through concrete and masonry walls, and concrete floor and roof slabs.

N. 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.
3. 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.

O. 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.
1. 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.

P. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.

Q. Verify final equipment locations for roughing-in.

R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements.

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 pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. 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.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
   1. Comply with ASTM F 402, for safe-handling practice of cleaners, primers, and solvent cements.
   2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
   3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
   4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
   5. PVC Nonpressure Piping: Join according to ASTM D 2855.
   6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
   1. Plain-End Pipe and Fittings: Use butt fusion.
   2. Plain-End Pipe and Socket Fittings: Use socket fusion.

M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.4 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:
   1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
   2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
   3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
   4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.

B. Field Welding: Comply with AWS D1.1.

3.7 GROUTING

A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

3.8 EXCAVATION AND BACKFILLING

A. Depth of bury of cover over exterior underground construction shall not be less than the following, unless otherwise noted or required.

1. Sewers: 4’-0”.
2. Water pipes: 4’-0”

B. Contractor shall do excavation required to install his (her) work, including pockets as required for fittings, etc., and after same are in place and tested and approved, he (she) shall replace drives, curbs and remove surplus earth and debris from the premises. Backfill under structures or pavement and within 5’-0” of same shall be thoroughly compacted aggregate. After installing pipe, backfill with compacted aggregate to 95% standard proctor density in 8” maximum lifts. Sand may be used for bedding the pipe, but shall be free of debris, rock, concrete, etc. and settled with water in layers as directed by Engineer. No materials except clean sand shall be placed within 6” of any pipe, sewer, conduit, cable or metal part.

C. Excessive excavations, excavations required to reach undisturbed soil, lower trenches, etc., shall be filled with thoroughly compacted small sized gravel to provide adequate bedding and support. Lines shall be bedded on materials at least 2” thick.

D. No trenches shall be filled until work has been inspected and approved by Engineer.

3.9 PRESSURE TESTS

A. Test shall be applied in Engineer's presence to all equipment, valves, devices, and piping, in groups or sections as work progresses. Unless otherwise noted, tests shall be made with water, after piping and equipment have been completely vented. Pressure shall be maintained for at least four hours without drop or visible leak. If leaks appear, they shall be repaired by replacing defective material or workmanship (peining, swaging or caulking will not be permitted), refill system with water, completely vented, and repeat test as often as necessary to show no drop in 2 hours. After tests, systems shall be completely drained. Precautions shall be taken to prevent freezing of test water and to protect or remove devices or equipment, or parts thereof, controls, gauges, thermometers, etc. which may be harmed by test pressures. Tests shall be made before painted and before covering.

B. Piping etc., shall be tested to at least 125 psi.

C. After pressure test, each complete system, piping and equipment shall be tested for complete drainage by opening unions, caps, plugs, faucets, or hose valves at low points. If system does not drain completely, piping shall be regraded and/or drain points added until complete drainage is demonstrated to Engineer. Systems shall be left dry in freezing weather.

<u>GENERAL DUTY VALVES FOR PLUMBING PIPING</u>

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Brass ball valves.
2. Bronze ball valves.
3. Bronze swing check valves.

1.2 SUBMITTALS

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

1.3 QUALITY ASSURANCE

A. ASME Compliance: ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.

B. NSF Compliance: NSF 61 for valve materials for potable-water service.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:
   1. Handlever: For quarter-turn valves NPS 6 and smaller.

E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
   1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.

F. Valve-End Connections:
   1. Flanged: With flanges according to ASME B16.1 for iron valves.
   2. Solder Joint: With sockets according to ASME B16.18.
   3. Threaded: With threads according to ASME B1.20.1.

2.2 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Lead-Free, Bronze Ball Valves with Bronze Trim: Lead-Free
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. American Valve, Inc.
      b. Conbraco Industries, Inc.; Apollo Valves.
      c. Crane Co.; Crane Valve Group; Crane Valves.
      d. Hammond Valve.
      e. Lance Valves; a division of Advanced Thermal Systems, Inc.
      f. Legend Valve.
      g. Milwaukee Valve Company.
      h. NIBCO INC.
      i. Red-White Valve Corporation.
      j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   2. Description:
      a. Standard: MSS SP-110.
      b. SWP Rating: 150 psig.
      c. CWP Rating: 400 psig minimum.
      d. Body Design: Two piece.
      e. Body Material: Bronze.
      f. Ends: Threaded or Soldered.
      g. Seats: PTFE or TFE.
      h. Stem: Bronze.
      i. Ball: Chrome-plated brass.
      j. Port: Full.

2.3 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. American Valve, Inc.
      b. Crane Co.; Crane Valve Group; Crane Valves.
      c. Crane Co.; Crane Valve Group; Jenkins Valves.
      d. Crane Co.; Crane Valve Group; Stockham Division.
      e. Hammond Valve.
      f. Kitz Corporation.
      g. Milwaukee Valve Company.
      h. NIBCO INC.
      i. Powell Valves.
      j. Red-White Valve Corporation.
      k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

   2. Description:
      a. Standard: MSS SP-80, Type 3.
      b. CWP Rating: 200 psig.
      c. Body Design: Horizontal flow.
      d. Body Material: ASTM B 62, bronze.
      e. Ends: Threaded or Soldered
      f. Disc: Bronze.

PART 3 - EXECUTION

3.1 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

3.2 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.

B. Select valves with the following end connections:
   1. For Copper Tubing, NPS 4 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.

3.3 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 4 and Smaller:

1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: Two piece, full port, brass or bronze with brass trim.
3. Bronze Swing Check Valves: Class 125, bronze disc.

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
1. Steel pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Equipment supports.

1.2 SUBMITTALS

A. Product Data: For the following:
1. Steel pipe hangers and supports.
2. Thermal-hanger shield inserts.
3. Powder-actuated fastener systems.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
1. Trapeze pipe hangers. Include Product Data for components.
2. Metal framing systems. Include Product Data for components.
3. Equipment supports.

C. Welding certificates.

1.3 DEFINITIONS

A. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

A. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

B. Manufacturers:
   1. AAA Technology & Specialties Co., Inc.
   2. Bergen-Power Pipe Supports.
   3. B-Line Systems, Inc.; a division of Cooper Industries.
   4. Carpenter & Paterson, Inc.
   5. Empire Industries, Inc.
   6. ERICO/Michigan Hanger Co.
   7. Globe Pipe Hanger Products, Inc.
   8. Grinnell Corp.
   9. GS Metals Corp.
   10. National Pipe Hanger Corporation.
   11. PHD Manufacturing, Inc.
   12. PHS Industries, Inc.
   13. Piping Technology & Products, Inc.
   14. Tolco Inc.

C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

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

2.4 METAL FRAMING SYSTEMS

A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. Manufacturers:
1. B-Line Systems, Inc.; a division of Cooper Industries.
2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
3. GS Metals Corp.
4. Power-Strut Div.; Tyco International, Ltd.
5. Thomas & Betts Corporation.
6. Tolco Inc.
7. Unistrut Corp.; Tyco International, Ltd.

C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 THERMAL-HANGER SHIELD INSERTS

A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.

B. Manufacturers:
1. Carpenter & Paterson, Inc.
2. ERICO/Michigan Hanger Co.
3. PHS Industries, Inc.
4. Pipe Shields, Inc.
5. Rilco Manufacturing Company, Inc.
6. Value Engineered Products, Inc.

C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass with vapor barrier.

D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass.

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

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

G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS

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

b. ITW Ramset/Red Head.
c. Masterset Fastening Systems, Inc.
d. MKT Fastening, LLC.
e. Powers Fasteners.

B. Mechanical-Expansion Anchors: Insert-wedge-type stainless steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
1. Manufacturers:
a. B-Line Systems, Inc.; a division of Cooper Industries.
b. Empire Industries, Inc.
c. Hilti, Inc.
d. ITW Ramset/Red Head.
e. MKT Fastening, LLC.
f. Powers Fasteners.

2.7 EQUIPMENT SUPPORTS

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

2.8 MISCELLANEOUS MATERIALS

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

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

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

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

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

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

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

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

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
5. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
6. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
7. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
8. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.

G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
   2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.

H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
   2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.

I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
   2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
   3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
   4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
   5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
   6. C-Clamps (MSS Type 23): For structural shapes.
   7. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
      a. Light (MSS Type 31): 750 lb.
      b. Medium (MSS Type 32): 1500 lb.
      c. Heavy (MSS Type 33): 3000 lb.
   8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.

9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
   2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
   3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
   2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
   3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.

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

M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

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

3.2 HANGER AND SUPPORT INSTALLATION

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

B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
   1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
   2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.

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

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

E. Fastener System Installation:

1. Install powder-actuated fasteners in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

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

G. Piping Hanger Spacing:

Pipe Size	Distance From Sleeve In Wall, End, Offset Or Corner to Hanger (Max.)	Hanger Spacing (Max.)
Up to 1¼"	2'-0"	8'-0"
1½ , 2"	3'-0"	10'-0"
2½" & Up	3'-0"	12'-0"

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

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

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

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

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

M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.

N. Insulated Piping: Comply with the following:
1. Attach clamps and spacers to piping.
    a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    c. Do not exceed pipe stress limits according to ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
4. Shield Dimensions for Pipe: Not less than the following:
   a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
   b. NPS 4: 12 inches long and 0.06 inch thick.
   c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
   d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
   e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
5. Pipes NPS 8 and Larger: Include wood inserts.
6. Insert Material: Length at least as long as protective shield.
7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

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

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

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

3.4 METAL FABRICATIONS

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

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

C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

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

3.6 PAINTING

A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
   1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

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

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.

1.2 SUBMITTALS

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

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch Stainless steel, 0.025-inch Aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: Black.
3. Background Color: White.

4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black.

C. Background Color: Yellow.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.

B. Pipe Label Color Schedule:

1. Domestic Water Piping:

a. Background Color: White.
b. Letter Color: Green.

2. Sanitary Waste and Storm Drainage Piping:

a. Background Color: White.
b. Letter Color: Black.

PLUMBING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Insulation Materials:

a. Flexible elastomeric.
b. Mineral fiber.

2. Insulating cements.
3. Adhesives.
4. Mastics.
5. Sealants.
6. Factory-applied jackets.
7. Tapes.
8. Securements.

1.2 SUBMITTALS

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

B. Shop Drawings:

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.

1.3 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Aeroflex USA Inc.; Aerocel.
b. Armacell LLC; AP Armaflex.
c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.

G. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Fibrex Insulations Inc.; Coreplus 1200.
b. Johns Manville; Micro-Lok.
c. Knauf Insulation; 1000 Pipe Insulation.
d. Manson Insulation Inc.; Alley-K.
e. Owens Corning; Fiberglas Pipe Insulation.

2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 INSULATING CEMENTS

A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Insulco, Division of MFS, Inc.; SmoothKote.
b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.

c. Rock Wool Manufacturing Company; Delta One Shot.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Flexible Elastomeric: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Aeroflex USA Inc.; Aeroseal.
b. Armacell LCC; 520 Adhesive.
c. RBX Corporation; Rubatex Contact Adhesive.

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-82.
b. Foster Products Corporation, H. B. Fuller Company; 85-20.
c. ITW TACC, Division of Illinois Tool Works; S-90/80.
d. Marathon Industries, Inc.; 225.
e. Mon-Eco Industries, Inc.; 22-25.

D. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-82.
b. Foster Products Corporation, H. B. Fuller Company; 85-20.
c. ITW TACC, Division of Illinois Tool Works; S-90/80.
d. Marathon Industries, Inc.; 225.

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-35.
b. Foster Products Corporation, H. B. Fuller Company; 30-90.
c. ITW TACC, Division of Illinois Tool Works; CB-50.
d. Marathon Industries, Inc.; 590.
e. Mon-Eco Industries, Inc.; 55-40.
f. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
5. Color: White.

C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-10.
b. Foster Products Corporation, H. B. Fuller Company; 35-00.
c. ITW TACC, Division of Illinois Tool Works; CB-05/15.
d. Marathon Industries, Inc.; 550.
e. Mon-Eco Industries, Inc.; 55-50.
f. Vimasco Corporation; WC-1/WC-5.

2. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 200 deg F.
4. Solids Content: 63 percent by volume and 73 percent by weight.
5. Color: White.

2.5 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.

2.6 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
b. Compac Corp.; 104 and 105.
c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

2.7 SECUREMENTS

A. Aluminum Bands: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing or closed seal.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products; Bands.
b. PABCO Metals Corporation; Bands.
c. RPR Products, Inc.; Bands.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.

    a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.

5. Handholes.
6. Cleanouts.

3.3 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Pipe: Install insulation continuously through floor penetrations.

3.4 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids,

and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.

3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or

union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.5 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.6 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.

3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.7 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Domestic Hot and Recirculated Hot Water: Insulation shall be one of the following:

1. Flexible Elastomeric: 1 inch thick.
2. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

C. Domestic Cold Water (Potable): Insulation shall be one of the following:

1. Flexible Elastomeric: 1/2 inch thick.
2. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.

DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes water-distribution piping and related components.

1.2 SUBMITTALS

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

B. Shop Drawings: Detail precast concrete vault assemblies and indicate dimensions, method of field assembly, and components.

C. Field quality-control test reports.

D. Operation and maintenance data.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
   2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.

B. Piping materials shall bear label, stamp, or other markings of specified testing agency.

C. Comply with ASTM F 645 for selection, design, and installation of thermoplastic water piping.

D. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.

E. NSF Compliance:
   1. Comply with NSF 61 for materials for water-service piping and specialties for domestic water.

1.4 PROJECT CONDITIONS

A. Interruption of Existing Water-Distribution Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service according to requirements indicated:
   1. Notify owner no fewer than two days in advance of proposed interruption of service.
   2. Do not proceed with interruption of water-distribution service without owner's permission.

1.5 COORDINATION

A. Coordinate connection to water main with utility company.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L, water tube, drawn temper.
   1. Copper, Solder-Joint Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.

B. Grooved-Joint, Ductile-Iron Pipe: AWWA C151, with cut, rounded-grooved ends.
   1. Grooved-End, Ductile-Iron Pipe Appurtenances:
      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) Anvil International, Inc.
         2) Victaulic Company of America.

2.2 JOINING MATERIALS

A. Refer to Division 22 Section "Common Work Results for Plumbing" for commonly used joining materials.

B. Brazing Filler Metals: AWS A5.8, BCuP Series.

2.3 GATE VALVES

A. AWWA, Cast-Iron Gate Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. American AVK Co.; Valves & Fittings Div.
      b. American Cast Iron Pipe Co.; American Flow Control Div.
      c. American Cast Iron Pipe Co.; Waterous Co. Subsidiary.
      d. Crane Co.; Crane Valve Group; Stockham Div.
      e. East Jordan Iron Works, Inc.
      f. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
      g. McWane, Inc.; Kennedy Valve Div.
      h. McWane, Inc.; M & H Valve Company Div.
      i. McWane, Inc.; Tyler Pipe Div.; Utilities Div.
      j. Mueller Co.; Water Products Div.
      k. NIBCO INC.
      l. U.S. Pipe and Foundry Company.
   2. Non-rising-Stem, Resilient-Seated Gate Valves:
      a. Description: Gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut.
         1) Standard: AWWA C509.
         2) Minimum Pressure Rating: 200 psig.

3) End Connections: Mechanical joint.
4) Interior Coating: Complying with AWWA C550.

B. Bronze Gate Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Div.
d. Hammond Valve.
e. Milwaukee Valve Company.
f. NIBCO INC.
g. Red-White Valve Corporation.
2. Non-rising-Stem Gate Valves:
a. Description: Class 125, Type 1, bronze with solid wedge, threaded ends, and malleable-iron handwheel.
1) Standard: MSS SP-80.

2.4 WATER METERS

A. Manufacturers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. AMCO Water Metering Systems.
b. Badger Meter, Inc.
c. Carlon Meter.
d. Hays Fluid Controls; a division of ROMAC Industries Inc.
e. McCrometer.
f. Mueller Co.; Hersey Meters.
g. Neptune Technology Group Inc.
h. Sensus Metering Systems.

B. Displacement-Type Water Meters:
1. Description: With bronze main case.
a. Standard: AWWA C700.
b. Registration: Flow in gallons.

C. Compound-Type Water Meters:
1. Description:
a. Standard: AWWA C702.
b. Registration: Flow in gallons.

2.5 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Conbraco Industries, Inc.
b. FEBCO; SPX Valves & Controls.
c. Flomatic Corporation.
d. Watts Water Technologies, Inc.

e. Zurn Plumbing Products Group; Wilkins Water Control Products Div.
2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
5. Body: Bronze for NPS 2 and smaller.
6. End Connections: Threaded for NPS 2 and smaller.
7. Configuration: Designed for horizontal flow.
8. Accessories:
   a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller.
   b. Air-Gap Fitting: ASME A112.1.2, matching backflow preventer connection.

B. Double-Check, Backflow-Prevention Assemblies:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Ames Fire & Waterworks; a division of Watts Regulator Co.
   b. Conbraco Industries, Inc.
   c. FEBCO; SPX Valves & Controls.
   d. Flomatic Corporation.
   e. Watts Water Technologies, Inc.
   f. Zurn Plumbing Products Group; Wilkins Water Control Products Div.
2. Standard: AWWA C510.
3. Operation: Continuous-pressure applications, unless otherwise indicated.
4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
5. Body: cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
6. End Connections: Flanged for NPS 2-1/2 and larger.
7. Configuration: Designed for horizontal flow.
8. Accessories: Ball valves with threaded ends on inlet and outlet of NPS 2 and smaller; OS&Y gate valves with flanged ends on inlet and outlet of NPS 2-1/2 and larger.

2.6 FIRE DEPARTMENT CONNECTIONS

A. Fire Department Connections:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Elkhart Brass Mfg. Co., Inc.
   b. Fire End & Croker Corporation.
   c. Guardian Fire Equipment, Inc.
   d. Kidde Fire Fighting.
   e. Potter Roemer.
   f. Reliable Automatic Sprinkler Co., Inc.
2. Description: Freestanding, with cast-bronze body, thread inlets according to NFPA 1963 and matching local fire department hose threads, and threaded bottom outlet. Include lugged caps, gaskets, and chains; lugged swivel connection and drop clapper for each hose-connection inlet; 18-inch- high brass sleeve; and round escutcheon plate.
   a. Standard: UL 405.
   b. Connections: Two NPS 2-1/2 inlets and one NPS 4 outlet.
   c. Inlet Alignment: Inline, horizontal.

d. Finish Including Sleeve: Rough chrome-plated.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.

B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.

C. Do not use flanges or unions for underground piping.

D. Flanges, unions, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.

E. Aboveground Water-Service Piping NPS 3/4 to NPS 2 shall be hard copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and brazed joints.

F. Aboveground NPS 4 and larger shall be the following:
1. Ductile-iron, grooved-end pipe; ductile-iron, grooved-end appurtenances; and grooved joints.

3.2 VALVE APPLICATIONS

A. General Application: Use the following for valves in vaults and aboveground:
a. Gate Valves, NPS 2 and Smaller: Bronze, non-rising stem.
b. Gate Valves, NPS 2-1/2 and Larger: AWWA, cast iron, OS&Y non-rising stem, resilient seated.

3.3 PIPING INSTALLATION

A. Extend water-service piping and connect to water-supply source and building-water-piping systems at outside face of building wall in locations and pipe sizes indicated.
1. Terminate water-service piping at building wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building-water-piping systems when those systems are installed.

B. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.

3.4 JOINT CONSTRUCTION

A. Make pipe joints according to the following:
1. Ductile-Iron Piping, Grooved Joints: Cut-groove pipe. Assemble joints with grooved-end, ductile-iron-piping couplings, gaskets, lubricant, and bolts according to coupling manufacturer's written instructions.
2. Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, with OD, and with system working pressure.

3.5 WATER METER INSTALLATION

A. Install water meters, piping, and specialties according to utility company's written instructions.

B. Water Meters: Install displacement-type water meters, NPS 2 and smaller, with shutoff valves on water meter inlets. Include valves on water meter outlets and valved bypass around meters unless prohibited by authorities having jurisdiction.

C. Water Meters: Install compound-type water meters, NPS 3 and larger. Include shutoff valves on water meter inlets and outlets and valved bypass around meters. Support meters, valves, and piping on brick or concrete piers.

3.6 BACKFLOW PREVENTER INSTALLATION

A. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.

B. Do not install backflow preventers that have relief drain in vault or in other spaces subject to flooding.

C. Do not install bypass piping around backflow preventers.

D. Support NPS 2-1/2 and larger backflow preventers, valves, and piping near floor and on brick or concrete piers.

3.7 FIELD QUALITY CONTROL

A. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.

B. Hydrostatic Tests: Test at not less than one-and-one-half times working pressure for two hours.
   1. Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig. Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.

C. Prepare reports of testing activities.

3.8 CLEANING

A. Clean and disinfect water-distribution piping as follows:
   1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
   2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.

3. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:
   a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
   b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for 3 hours.
   c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
   d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.

B. Prepare reports of purging and disinfecting activities.

DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following domestic water piping specialties:
   1. Backflow preventers.
   2. Strainers.
   3. Wall hydrants.
   4. Water hammer arresters.

1.2 SUBMITTALS

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

B. Field quality-control test reports.

C. Operation and maintenance data.

1.3 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.4 QUALITY ASSURANCE

A. NSF Compliance:
   1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
   2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 - PRODUCTS

2.1 BACKFLOW PREVENTERS

A. Double-Check Assemblies:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Ames Co.
   b. Conbraco Industries, Inc.
   c. FEBCO; SPX Valves & Controls.
   d. Flomatic Corporation.
   e. Watts Industries, Inc.; Water Products Div.
   f. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1015.
3. Operation: Continuous-pressure applications, unless otherwise indicated.
4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
5. Size: Per manufacturer's recommendations
6. Design Flow Rate: Per manufacturer's recommendations
7. Selected Unit Flow Range Limits: Per manufacturer's recommendations
8. Pressure Loss at Design Flow Rate: 15 psig or as necessary to ensure domestic water pressure as required by governing codes.
9. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
10. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
11. Configuration: Designed for horizontal, straight through Insert configuration flow.
12. Accessories:
    a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.

2.2 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:
1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations, unless otherwise indicated.
5. Perforation Size:
   a. Strainers NPS 2 and Smaller: 0.033 inch.
   b. Strainers NPS 2-1/2 to NPS 4: 0.062 inch.
   c. Strainers NPS 5 and Larger: 0.125 inch.
6. Drain: Factory-installed, hose-end drain valve.

2.3 WALL HYDRANTS

A. Non-freeze Commercial Wall Hydrants: Basis-of-Design Product: Woodford Model 67 with removeable key.

B. Provide the product listed in the plumbing fixture schedule or equivalent product by one of the following:
   a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   b. Tyler Pipe; Wade Div.
   c. Watts Drainage Products Inc.
   d. Woodford Manufacturing Company.
   e. Zurn Plumbing Products Group; Light Commercial Operation.

C. Automatic draining, with hose connection backflow protection.

D. ASSE Standard 1052 approved.

2.4 WATER HAMMER ARRESTERS

A. Water Hammer Arresters:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. AMTROL, Inc.
      b. Josam Company.
      c. MIFAB, Inc.
      d. PPP Inc.
      e. Sioux Chief Manufacturing Company, Inc.
      f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
      g. Tyler Pipe; Wade Div.
      h. Watts Drainage Products Inc.
      i. Zurn Plumbing Products Group; Specification Drainage Operation.
   2. Standard: ASSE 1010 or PDI-WH 201.
   3. Type: Metal bellows or Copper tube with piston.
   4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
   1. Locate backflow preventers as indicated on plan sheets.

2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
3. Do not install bypass piping around backflow preventers.

C. Install Y-pattern strainers for water on supply side of each control valve, water pressure-reducing valve, solenoid valve, and pump.

D. Install water hammer arresters in water piping according to PDI-WH 201.

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

F. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
1. Double-check backflow-prevention assemblies.

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and prepare test reports:
1. Test each double-check backflow-prevention assembly according to authorities having jurisdiction and the device's reference standard.

B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following soil and waste, sanitary drainage and vent piping inside the building:
1. Pipe, tube, and fittings.
2. Special pipe fittings.

1.2 SUBMITTALS

A. Field quality-control inspection and test reports.

1.3 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:
1. Soil, Waste, and Vent Piping: 10-foot head of water.

1.4 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; and "NSF-drain" for plastic drain piping.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Hub-and-Spigot, Cast-Iron Pipe and Fittings: ASTM A 74, Service class.
   1. Gaskets: ASTM C 564, rubber.

B. Solid-Wall PVC Pipe: ASTM D 2665, solid-wall drain, waste, and vent.
   1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Special pipe fittings with pressure ratings at least equal to piping pressure ratings may be used in applications below, unless otherwise indicated.

B. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.

C. Aboveground, soil, waste, and vent piping NPS 4 and smaller shall be any of the following:
   1. Service class, hub-and-spigot, cast-iron soil pipe and fittings; gaskets; and compression joints.
   2. Solid-wall Cellular-core PVC pipe, PVC socket fittings, and solvent-cemented joints.

D. Underground, soil, waste, and vent piping NPS 4 and smaller shall be any of the following:
   1. Service class, hub-and-spigot, cast-iron soil pipe and fittings; gaskets; and compression joints.
   2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

3.2 PIPING INSTALLATION

A. Sanitary sewer piping outside the building is specified in Section "Facility Sanitary Sewers."

B. Basic piping installation requirements are specified in Section "Common Work Results for Plumbing."

C. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.

D. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Section "Common Work Results for Plumbing."

E. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Wall penetration systems are specified in Section "Common Work Results for Plumbing."

F. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

G. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

H. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

I. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise required by code or indicated :
   1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
   2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
   3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

J. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

K. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.

L. Install underground PVC soil and waste drainage piping according to ASTM D 2321.

M. 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 Section "Common Work Results for Plumbing."

B. Cast-Iron, Soil-Piping Joints: Make joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

1. Gasketed Joints: Make with rubber gasket matching class of pipe and fittings.

C. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.4 VALVE INSTALLATION

A. General-duty valves are specified in Section "General-Duty Valves for Plumbing Piping."

B. Check Valves: Install swing check valve, downstream from shutoff valve, on each sewage pump discharge.

3.5 HANGER AND SUPPORT INSTALLATION

A. Seismic-restraint devices are specified in Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Pipe hangers and supports are specified in Section "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. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Install supports according to Section "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 hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
2. NPS 3: 60 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
4. NPS 6: 60 inches with 3/4-inch rod.
5. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

G. Install supports for vertical cast-iron soil piping every 15 feet.

H. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
2. NPS 3: 48 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
4. NPS 6: 48 inches with 3/4-inch rod.

I. Install supports for vertical PVC piping every 48 inches.

J. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

A. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

B. Connect drainage and vent piping to the following:
1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

3.7 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 and before setting fixtures.
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 sanitary drainage and vent piping according to procedures of authorities having jurisdiction.
1. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
2. Prepare reports for tests and required corrective action.

3.8 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.

3.9 PROTECTION

A. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

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. Roof flashing assemblies.
4. Miscellaneous sanitary drainage piping specialties.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for grease interceptors.

1.3 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Exposed Cast-Iron Cleanouts:

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

a. Josam Company; Josam Div.
b. MIFAB, Inc.
c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
d. Watts Drainage Products Inc.
e. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M for cast iron cleanout test tee.
3. Size: Same as connected drainage piping
4. Body Material: As required to match connected piping.
5. Closure: Raised heat plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Cast-Iron Floor Cleanouts:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

      a. Josam Company; Josam Div.
      b. Oatey.
      c. Sioux Chief Manufacturing Company, Inc.
      d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
      e. Watts Drainage Products Inc.
      f. Zurn Plumbing Products Group; Light Commercial Operation.
      g. Zurn Plumbing Products Group; Specification Drainage Operation.

   2. Standard: ASME A112.36.2M for heavy-duty, adjustable housing cleanout.
   3. Size: Same as connected branch.
   4. Body or Ferrule: Cast Iron.
   5. Clamping Device: Required.
   6. Outlet Connection: Inside caulk.
   7. Closure: Brass plug with straight threads and gasket.
   8. Adjustable Housing Material: Cast iron.
   9. Frame and Cover Material and Finish: Polished bronze.
   10. Frame and Cover Shape: Round
   11. Top Loading Classification: Heavy Duty.
   12. Riser: ASTM A 74, service class, cast-iron drainage pipe fitting and riser to cleanout.

C. Wall Cleanouts:

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

      a. Josam Company; Josam Div.
      b. MIFAB, Inc.
      c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
      d. Watts Drainage Products Inc.
      e. Zurn Plumbing Products Group; Specification Drainage Operation.

   2. Standard: ASME A112.36.2M. Include wall access.
   3. Size: Same as connected drainage piping.
   4. Body: 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 bronze cover plate with screw.
   8. Wall Access: Round wall-installation frame and cover.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on the drawings or a comparable product 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. Watts Drainage Products Inc.
   g. Zurn Plumbing Products Group; Light Commercial Operation.
   h. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: Gray Iron.
5. Outlet: Bottom.
6. Top or Strainer Material: Bronze.
7. Top of Body and Strainer Finish: Nickel bronze.
8. Top Shape: Round.
9. Trap Pattern: Deep-seal p-trap.

2.3 ROOF VENT FLASHING ASSEMBLIES

A. Roof Vent Flashing Assemblies:

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

   a. Thaler Metal Industries Ltd.

B. Description: Manufactured assembly made of 0.064-inch-thick, aluminum manufactured to CSA B272-93 with EPDM triple pressure grommet seal and EPDM Base Seal.

1. Warranty: 20-year against leaks, condensation, and defects in materials and/or manufacture.

2.4 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.

5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

B. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 2 inches above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Section "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. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate at base of each vertical soil and waste stack.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. 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.

F. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.

G. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.

H. Assemble open drain fittings and install with top of hub 2 inches.

I. Install deep-seal traps on floor drains and other waste outlets.

J. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

K. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 CONNECTIONS

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

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

3.3 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each grease interceptor.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section "Identification for Plumbing Piping and Equipment."

3.4 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.

SANITARY SEWERAGE PUMPS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following sewage pumps and accessories for sanitary drainage piping systems in buildings:
1. Submersible, quick-disconnect sewage pumps.

B. See Section "Sump Pumps" for applications in storm-drainage systems.

1.2 SUBMITTALS

A. Product Data: For each type and size of sewage pump specified. Include certified performance curves with operating points plotted on curves; and rated capacities of selected models, furnished specialties, and accessories.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Operation and maintenance data.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 SUBMERSIBLE, QUICK-DISCONNECT SEWAGE PUMPS

A. Description: Factory-assembled and -tested, duplex, single-stage, centrifugal, end-suction, submersible, direct-connected sewage pumps complying with UL 778 and with HI 1.1-1.2 and HI 1.3 for submersible sewage pumps and with SWPA's "Submersible Sewage Pumping Systems (SWPA) Handbook" for guide-rail supports. Include reverse-flow assembly.
1. Manufacturers:
a. Chicago Pump Company; a division of Yeomans Chicago Corporation.
b. Deming Pumps; Crane Pumps & Systems.
c. EBARA International Corporation; Standard Pump Division.
d. Fairbanks Morse; Pentair Pump Group (The).
e. Federal Pump Corp.
f. Flygt; ITT Industries.
g. Gorman-Rupp Company (The).
h. Goulds Pumps; ITT Industries.
i. HOMA Pump Technology.
j. Hydromatic Pumps; Pentair Pump Group (The).
k. KSB Inc.
l. Metropolitan Industries, Inc.
m. Myers, F. E.; Pentair Pump Group (The).
n. Paco Pumps, Inc.
o. PUMPEX, Inc.
p. Stancor, Inc.
q. Sta-Rite Industries, Inc.

r. Swaby Manufacturing Co.
s. Tsurumi (America), Inc.
t. USFilter/Davco Products.
u. Weil Pump Company, Inc.
v. Weinman Div.; Crane Pumps & Systems.
w. Yeomans Chicago Corporation.
x. Zoeller Company.

2. Casing: Cast iron, with open inlet, legs (or guide-rail supports) that elevate pump to permit flow into impeller, and vertical discharge with companion flange for piping connection.
3. Impeller: ASTM A 48/A 48M, Class No. 25 A or higher cast iron; statically and dynamically balanced, open or semiopen, nonclog design and capable of handling solids; overhung, single suction, and keyed and secured to shaft.
4. Pump and Motor Shaft: Stainless steel Stainless steel or steel Steel, with factory-sealed, grease-lubricated ball bearings and double mechanical seals.
5. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump. Comply with Section "Common Motor Requirements for Plumbing Equipment."
   a. Moisture-Sensing Probe: Internal moisture sensor and moisture alarm.
   b. Motor Housing Fluid: Air or oil.
6. Guide-Rail Supports: Include the following for each sewage pump:
   a. Guide Rails: Vertical pipes or structural members, made of galvanized steel or other corrosion-resistant metal, attached to baseplate and basin sidewall or cover.
   b. Baseplate: Corrosion-resistant metal plate, attached to basin floor, supporting guide rails and stationary elbow.
   c. Pump Yoke: Motor-mounted or casing-mounted yokes or other attachments for aligning pump during connection of flanges.
   d. Movable Elbow: Pump discharge-elbow fitting with flange, seal, and positioning device.
   e. Stationary Elbow: Fixed discharge-elbow fitting with flange that mates to movable-elbow flange and support attached to baseplate.
   f. Lifting Cable: Stainless steel; attached to pump and cover at manhole.

B. Pump Discharge Piping: Factory or field fabricated, ASTM A 53/A 53M, Schedule 40, galvanized-steel pipe.

C. Controls: NEMA 250, Type 4X enclosure, pedestal-mounted float switch; with floats, float rods, and rod buttons.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Excavating, trenching, and backfilling are specified in Section "Earth Moving."

B. Install sewage pumps according to applicable requirements in HI 1.4.

C. Install pumps and arrange to provide access for maintenance including removal of motors, impellers, couplings, and accessories.

D. Set submersible sewage pumps on basin and pit floors. Make direct connections to sanitary drainage piping.
   1. Anchor guide-rail supports to basin bottom and sidewalls. Install pumps so pump and discharge pipe disconnecting flanges make positive seals when pumps are lowered into place.

E. Support piping so weight of piping is not supported by pumps.

F. Piping installation requirements are specified in Section "Sanitary Waste and Vent Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

G. Install piping adjacent to sewage pumps to allow service and maintenance.

H. Connect sanitary drainage piping to pumps. Install discharge piping equal to or greater than size of pump discharge piping. Refer to Section "Sanitary Waste and Vent Piping."

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

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

DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

   1. Domestic-water-in-coil, instantaneous water heaters.
   2. Heat-exchanger accessories.

1.2 SUBMITTALS

A. Product Data: For each type and size of water heater indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Operation and maintenance data.

D. Warranty.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9" for all components that will be in contact with potable water.

1.4 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of water heaters that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including storage tank and supports.
b. Faulty operation of controls.
c. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Period(s): From date of Substantial Completion:

a. Instantaneous Water heaters: Five year(s).

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 INSTANTANEOUS WATER HEATERS

A. Domestic-Water-in-Coil, Instantaneous Water heaters:

1. Available Manufacturers:

a. Eemax Pro Series
b. Electric Heater Company (The); Hubbell Heaters Division.
c. Graham Corporation.
d. Leslie Controls, Inc.

2. Description: Tankless, packaged assembly of heat-exchanger coils, controls, and specialties for heating domestic water in coils with steam in shell.
3. Construction: NSF61 listed materials, with powder coated galvanized steel, stainless steel water heaters, and sheathed copper heating elements.

a. Maximum Operating Pressure Rating: 150 psig.
b. Maximum Operating Temperature: 180°F.

4. Temperature Control: Adjustable thermostat that is capable of maintaining outlet-water temperature within 3 deg F of setting.

5. Safety Control: Automatic, high-temperature-limit cutoff device or system.
6. Miscellaneous Components: Strainers, valves, and piping.
7. Stand: Factory fabricated for floor mounting.
8. Disconnect Switch: Factory installed, non-fused.
9. Capacity and Characteristics:

    a. Per equipment schedule on plans.

2.3 WATER HEATER ACCESSORIES

A. Electronic Water Conditioner:

1. Available Manufacturers:

    a. Aqua-Rex.
    b. Eddy.
    c. Scale Blaser.

2. Designed for up to 1” pipe. Provide transformers, wiring, and all necessary parts and accessories per manufacturer recommendations.
3. Install per manufacturer recommendations in location indicated on the project plans.

B. Combination Air Eliminator and Dirt Separator:

1. Available Manufacturers:

    a. Spirotherm.
    b. Taco.
    c. Caleffi.

2. Brass body, glass reinforced nylon coalescing mesh element removable for cleaning, stainless steel float linkages, stainless steel float guide pin.
3. Sweat Connections.
4. External Removable rare-earth magnet.
5. Maximum Working Pressure: 150 psi.

PART 3 - EXECUTION

3.1 HEAT-EXCHANGER INSTALLATION

A. Install water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

B. Anchor water heaters to substrate.

C. Install water conditioner on cold water supply piping within 2’ of the water heater.

D. Install air and dirt eliminator on cold water supply piping after the water conditioner.

3.2 CONNECTIONS

A. Install piping adjacent to water heaters to allow service and maintenance. Arrange piping for easy removal of water heaters.

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

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

3.3 FIELD QUALITY CONTROL

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

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

B. Remove and replace water heaters that do not pass tests and inspections and retest as specified above.

3.4 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain water heaters.

PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUBMITTALS

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

B. Operation and maintenance data.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.

B. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

C. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

PART 2 - PRODUCTS

2.1 PLUMBING FIXTURES

A. Basis of Design:

1. Provide product make and model listed in plumbing schedule on sheet P501. Equivalent products may be provided from the other manufacturers listed in the plumbing schedule.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.

B. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.

C. Install wall-mounting fixtures with tubular waste piping attached to supports.

D. Install fixtures level and plumb according to roughing-in drawings.

E. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.

F. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.

G. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.

H. Install toilet seats on water closets.

I. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

J. Install traps on fixture outlets:

1. Exception: Omit trap on fixtures with integral traps.
2. Exception: Omit trap on indirect wastes, unless otherwise indicated.

K. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color.

3.2 CONNECTIONS

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

B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

3.3 FIELD QUALITY CONTROL

A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.

B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.

C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.

D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
1. Piping materials and installation instructions common to most piping systems.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Sleeves.
5. Escutcheons.
6. Grout.
7. HVAC demolition.
8. Equipment installation requirements common to equipment sections.
9. Concrete bases.
10. Supports and anchorages.

1.2 SUBMITTALS

A. Welding certificates.

B. Submit product information for all materials used for the various mechanical systems.

1.3 REFERENCES

A. Standards:
1. ASME American Society of Mechanical Engineers.

2. AWWA American Water Works Association.
3. UL Underwriters Laboratories, Inc.
4. MCA Mechanical Contractors Association.
5. IBR Institute of Boiler and Radiators Manufacturers AISE Association of Iron & Steel Engineers.
6. SAE Society of Automotive Engineers.
7. NEMA National Electric Manufacturers Association ASTM American Society for Testing and Materials.
8. ANSI American National Standard Institute.
9. AWS American Welding Society.

1.4 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, 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. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.5 QUALITY ASSURANCE

A. All equipment and materials shall be new and of first quality. Manufactured products shall be Manufacturer's standard product with specified options but shall not be field or factory modified unless specified. All materials and equipment shall bear the Manufacturer's nameplate or marking with type, size, catalog numbers and ratings as appropriate.

B. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

C. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

D. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Acceptance (at site): Take delivery of all items delivered to site. Be responsible for inspection of materials and equipment to detect transit damage.

B. Protection (prior to application or installation):
   1. Materials shall be stored inside building. Piping may be stored outside.
   2. Be responsible for all damage to materials stored on site.

1.7 PROJECT CONDITIONS

A. When existing conditions prohibit the proper installation as shown on the Drawings or as specified herein, the Contractor shall notify the Engineer, in writing, requesting a solution.

B. Contractor is responsible for the verification of new and existing conditions on the site before that particular phase of installation begins.

1.8 WARRANTY

A. Contractors and manufacturers warranty shall be 1 year after substantial completion.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

A. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

B. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

D. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.

E. Welding Filler Metals: Comply with AWS D10.12.

F. Solvent Cements for Joining Plastic Piping:
   1. CPVC Piping: ASTM F 493.
   2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

2.3 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.4 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

B. Sealing Elements: NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

C. Pressure Plates: Carbon steel. Include two for each sealing element.

D. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.5 SLEEVES

A. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

B. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. 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.

D. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.

E. PVC Pipe: ASTM D 1785, Schedule 40.

F. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.6 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.
   1. Finish: Polished chrome-plated.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
   1. Finish: Polished chrome-plated Rough brass Polished chrome-plated and rough brass.

2.7 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 HVAC DEMOLITION

A. Refer to Section "Cutting and Patching" and Section "Selective Structure Demolition" for general demolition requirements and procedures.

B. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.
   1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
   2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
   3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
   4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
   5. Equipment to Be Removed: Disconnect and cap services and remove equipment.
   6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
   7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

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. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. “Street fittings” shall not be used.

L. Select system components with pressure rating equal to or greater than system operating pressure.

M. Install escutcheons for penetrations of walls, ceilings, and floors.

N. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

O. Where pipe passes through building walls and floors cuts shall be square or round and ground smooth.

P. 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.
   3. 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.

Q. 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.

1. 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.

R. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Section "Penetration Firestopping" for materials.

S. Verify final equipment locations for roughing-in.

T. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Sections specifying piping systems.

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 pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. 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.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
1. Comply with ASTM F 402, for safe-handling practice of cleaners, primers, and solvent cements.
2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.

3. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
4. PVC Nonpressure Piping: Join according to ASTM D 2855.

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
1. Plain-End Pipe and Fittings: Use butt fusion.
2. Plain-End Pipe and Socket Fittings: Use socket fusion.

M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

N. Bending of pipe will not be permitted, only ells shall be utilized for a change in direction.

3.4 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:
1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.6 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and 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 drawings, 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. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Section "Cast-in-Place Concrete."

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.8 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor HVAC materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.9 GROUTING

A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

3.10 TESTING OF PIPING SYSTEMS

A. Piping Systems:
1. Contractor shall subject all piping and equipment to a test of 125 psi for a period of 8 hours and all leaks developed shall be repaired and the test repeated until the system is absolutely tight.
2. Disconnect all traps and devices not rated for operation at test pressures.
3. All instruments and equipment required for testing shall be furnished by the Contractor and tests shall, if so requested, be made in the presence of the Engineer.

3.11 ADJUST AND CLEAN

A. Protection of Completed Work:
1. When work is completed it shall, when it is subject to damage by ongoing construction, be protected from this damage.
2. As work is being installed, equipment and piping shall be protected from other ongoing construction or from its own construction. Exposed piping ends should not be temporarily covered; hanger shall be supplied in sufficient number to prevent warping or bending of pipe.

HVAC INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Insulation Materials:
a. Flexible elastomeric.
b. Mineral fiber.

2. Fire-rated insulation systems.
3. Adhesives.
4. Mastics.
5. Sealants.
6. Factory-applied jackets.
7. Field-applied jackets.
8. Tapes.
9. Securements.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).

1.3 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having

jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.4 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Section "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

H. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

I. Mineral-Fiber, Preformed Pipe Insulation: Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 FIRE-RATED INSULATION SYSTEMS

A. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 2-hour fire rating by a NRTL acceptable to authority having jurisdiction.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

D. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

E. PVC Jacket Adhesive: Compatible with PVC jacket.

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 permat 43-mildry film thickness.
2. Service Temperature Range: Minus 20 to plus 180 deg F.
3. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
4. Color: White.

2.5 SEALANTS

A. PVC Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.

2.6 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.7 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Adhesive: As recommended by jacket material manufacturer.
2. Color: White
3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

D. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.
1. Finish and thickness are indicated in field-applied jacket schedules.

2.8 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Width: 3 inches.
2. Thickness: 11.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Width: 3 inches.
2. Thickness: 6.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.

1. Width: 2 inches.
2. Thickness: 6 mils.
3. Adhesion: 64 ounces force/inch in width.
4. Elongation: 500 percent.
5. Tensile Strength: 18 lbf/inch in width.

2.9 SECUREMENTS

A. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch or 0.135-inch diameter shank, length to suit depth of insulation indicated.

2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch or 0.135-inch diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.

3. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

   a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

4. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inchesin diameter.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

1. Verify that systems and equipment to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 incheso.c.

3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 incheso.c.

    a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inchesbeyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
    1. Extend jacket of outdoor insulation outside roof flashing at least 2 inchesbelow top of roof flashing.
    2. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
    1. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
    2. Seal jacket to wall flashing with flashing sealant.

C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.

    1. Comply with requirements in Section "Penetration Firestopping"irestopping and fire-resistive joint sealers.

E. Insulation Installation at Floor Penetrations:

    1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match

adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
2. Pipe: Install insulation continuously through floor penetrations.
3. Seal penetrations through fire-rated assemblies. Comply with requirements in Section "Penetration Firestopping."

3.5 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.6 MINERAL-FIBER INSULATION INSTALLATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

a. On duct sides with dimensions 16 inches and smaller, no pins required.
b. On duct sides with dimensions larger than 16 inches, place pins 16 incheso.c. each way, and 3 inchesmaximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
d. Do not overcompress insulation during installation.
e. Impale insulation over pins and attach speed washers.

f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
5. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 incheso.c.

B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

a. On duct sides with dimensions 16 inchesand smaller, no pins required.
b. On duct sides with dimensions larger than 16 inches, space pins 16 incheso.c. each way, and 3 inchesmaximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
d. Do not overcompress insulation during installation.
e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
5. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 incheso.c.

3.7 FIELD-APPLIED JACKET INSTALLATION

A. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

3.8 FIRE-RATED INSULATION SYSTEM INSTALLATION

A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.

B. Insulate duct access panels and doors to achieve same fire rating as duct.

C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Section "Penetration Firestopping."

3.9 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor supply and outdoor air.
2. Indoor return air.
3. Indoor, Type I, commercial, kitchen hood exhaust.
4. Indoor, oven and warewash exhaust.
5. Indoor, exhaust between isolation damper and penetration of building exterior.
6. Outdoor, supply and return.

B. Items Not Insulated:
1. Factory-insulated flexible ducts.
2. Factory-insulated access panels and doors.

3.10 INDOOR DUCT INSULATION SCHEDULE

A. Concealed, Supply Air, round, duct insulation shall be the following:
1. Mineral-Fiber Blanket: 2-1/8 inchesthick and 0.75-lb/cu. ft.nominal density..

B. Concealed, Supply Air, rectangular, duct insulation shall be the following:
1. Mineral-Fiber Board: 1-1/2 inchesthick and 3-lb/cu. ft.nominal density.

C. Concealed, Neutral Air, round and rectangular, duct insulation shall be the following:
1. Mineral-Fiber Blanket: 2-1/8 inches thick and 0.75-lb/cu. ft. nominal density.

D. Concealed, Return Air, round and rectangular, duct insulation shall be the following:
1. Mineral-Fiber Blanket: 2-1/8 inches thick and 0.75-lb/cu. ft. nominal density.

E. Concealed, Type I, Commercial, Kitchen Hood Exhaust Duct and Plenum Insulation: Fire-rated blanket or board; thickness as required to achieve 2-hour fire rating.

F. Exposed, Supply Air, round, duct insulation shall be the following:
1. Double-Wall Spiral Duct with Mineral-Fiber Blanket Core: 1 thick and 1-lb/cu. ft.nominal density.

G. Exposed, Supply/Neutral/Return Air, rectangular, duct insulation shall be the following:
   1. Mineral-Fiber Board: 1 inches thick and 6-lb/cu. ft.nominal density.

H. Exposed, Type I, Commercial, Kitchen Hood Exhaust Duct and Plenum Insulation: Fire-rated blanket or board; thickness as required to achieve 2-hour fire rating.

3.11 ABOVEGROUND, OUTDOOR DUCT INSULATION SCHEDULE

A. Insulation materials and thicknesses are identified below. If more than one material is listed for a duct system, selection from materials listed is Contractor's option.

B. Exposed, rectangular, duct insulation shall be the following:
   1. Mineral-Fiber Board: 2 inchesthick and 3-lb/cu. ft.nominal density.

3.12 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

3.13 PIPING INSULATION SCHEDULE

A. Condensate Water:

   1. All Pipe Sizes: Insulation shall be one of the following:
      a. Flexible Elastomeric: 1/2 inchthick.
      b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inchthick.

B. Refrigerant Suction, Liquid, and Hot-Gas Piping:

   1. All Pipe Sizes: Insulation shall be the following:
      a. Flexible Elastomeric: 1 inchthick.

C. Refrigerant Suction and Hot-Gas Flexible Tubing:

   1. All Pipe Sizes: Insulation shall be the following:

      a. Flexible Elastomeric: 1 inchthick.

3.14 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. Ducts and Plenums, Exposed.

   1. Aluminum, Smooth: 0.024 inchthick.

C. Piping, Exposed:

1. PVC: 30 milsthick.

SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes control sequences for the following HVAC systems, subsystems, and equipment:
   1. Packaged Rooftop Makeup Air Unit.
   2. Roof Mounted Fans.
   3. Combination Louver Dampers.
   4. Restroom Exhaust Fans.

1.2 PACKAGED ROOFTOP MAKEUP AIR UNIT CONTROL SEQUENCES

A. Fan and Louver Tags:
   1. MAU-01
   2. L-EX

B. Fan: Shall operate during heating and ventilation mode.

C. Heating Mode: Unit shall operate to maintain the thermostat set point.

D. Ventilation: The fan shall run continuously to maintain ventilation of the motor room. The damper installed on the existing louver shall be interlocked to be open when MAU-01 is active.

1.3 ROOF MOUNTED FAN(S)

A. Fan Tags:
   1. EF-01
   2. SF-01

B. Operation: Fans shall run continuously to maintain ventilation of the wet well.

C. Fan and Louver Tags:
   1. EF-02
   2. L-01

D. Operation: Fan shall operate continuously when indoor air temperature is above 80°F The damper on louver L-01 shall be interlocked to be open when EF-02 is active.

E. Fan Tag:

F. Operation: Fan shall be controlled by vacancy switch controlling restroom lighting. Lighting and the exhaust fan shall be manually activated and deactivated after occupancy is not detected for 15 minutes.

METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Single-wall rectangular ducts and fittings.
2. Single-wall round ducts and fittings.
3. Sheet metal materials.
4. Sealants and gaskets.
5. Hangers and supports.

B. Related Sections:
1. Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.2 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated.
1. Static-Pressure Classes:
a. Supply Ducts (except in Mechanical Rooms): 1-inch wg
b. Return Ducts (Negative Pressure): 1-inch wg
c. Exhaust Ducts (Negative Pressure): 1-inch wg
2. Leakage Class:
a. Round Supply-Air Duct: 3 cfm/100 sq. ft. at 1-inch wg.
b. Rectangular Supply-Air Duct: 6 cfm/100 sq. ft. at 1-inch wg.

B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".

1.3 SUBMITTALS

A. Delegated-Design Submittal:
1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.
5. Design Calculations: Calculations for selecting hangers and supports.

1.4 QUALITY ASSURANCE

A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 – " Systems and Equipment" and Section 7 – "Construction and System Start-up."

B. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 – “HVAC System Construction and Insulation.”

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
   1. Transverse Joints in Ducts Larger Than 60 Inchesin Diameter: Flanged.

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
   1. Fabricate round ducts larger than 90 in diameter with butt-welded longitudinal seams.

D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
1. Galvanized Coating Designation: G90

C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.

2.4 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:
1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: 4 inches
3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.

C. Water-Based Joint and Seam Sealant:
1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Flanged Joint Sealant: Comply with ASTM C 920.
   1. General: Single-component, acid-curing, silicone, elastomeric.
   2. Type: S.
   3. Grade: NS.
   4. Class: 25.
   5. Use: O.

2.5 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."

C. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

D. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

F. Trapeze and Riser Supports:
   1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section "Air Duct Accessories" for fire and smoke dampers.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials.

3.2 ADDITIONAL INSTALLATION REQUIREMENTS FOR COMMERCIAL KITCHEN HOOD EXHAUST DUCT

A. Install commercial kitchen hood exhaust ducts without dips and traps that may hold grease, and sloped a minimum of 2 percent to drain grease back to the hood.

B. Install fire-rated access panel assemblies at each change in direction and at maximum intervals of 12 feetin horizontal ducts, and at every floor for vertical ducts, or as indicated on Drawings. Locate access panel on top or sides of duct a minimum of 1-1/2 inchesfrom bottom of duct.

C. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.

3.3 SEAM AND JOINT SEALING

A. Seal duct seams and joints for duct static-pressure and leakage classes specified in "Performance Requirements" Article, according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 1-2, "Standard Duct Sealing Requirements," unless otherwise indicated.

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
   1. Where practical, install concrete inserts before placing concrete.
   2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
   3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inchesthick.
   4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inchesthick.

5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inchesof each elbow and within 48 inchesof each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in painting Sections.

3.6 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as follows:
   1. Commercial Kitchen Hood Exhaust Ducts: Comply with NFPA 96.
      a. Exposed to View: Type 304, stainless-steel sheet.
      b. Concealed: Carbon-steel sheet.
      c. Welded seams and joints.
   2. Dishwasher Hood Exhaust Ducts:
      a. Type 304, stainless-steel sheet.
      b. Welded seams and flanged joints with watertight EPDM gaskets.

B. Elbow Configuration:
   1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
      a. Velocity 1000 fpm or Lower:
         1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
      b. Velocity 1000 to 1500 fpm:
         1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
         2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
         3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
      c. Velocity 1500 fpmor Higher:
         1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.

2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."

2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."
   a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
      1) Velocity 1000 fpmor Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
      2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
      3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
   b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
   c. Round Elbows, 14 Inchesand Larger in Diameter: Standing seam.

C. Branch Configuration:
   1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."
      a. Rectangular Main to Rectangular Branch: 45-degree entry.
      b. Rectangular Main to Round Branch: High efficiency takeoff with gasket.
   2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals."
      a. Velocity 1000 fpmor Lower: 90-degree tap.
      b. Velocity 1000 fpmor Higher: 45-degree lateral.

AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Control dampers.
   2. Flexible connectors.

1.2 SUBMITTALS

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

B. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.3 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with AMCA 500-D testing for damper rating.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
   1. Galvanized Coating Designation: G90.
   2. Exposed-Surface Finish: Mill phosphatized.

C. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.

D. Tie Rods: Galvanized steel, 1/4-inchminimum diameter for lengths 36 inchesor less; 3/8-inchminimum diameter for lengths longer than 36 inches.

2.2 CONTROL DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. American Warming and Ventilating; a division of Mestek, Inc.
   2. Greenheck Fan Corporation.
   3. Nailor Industries Inc.
   4. NCA Manufacturing, Inc.
   5. Ruskin Company.
   6. Vent Products Company, Inc.

B. Low-leakage rating and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.

C. Frames:
   1. Hat shaped.
   2. Galvanized-steel channels, 0.064 inchthick.
   3. Mitered and welded corners.

D. Blades:
   1. Multiple blade with maximum blade width of 8 inches.
   2. Opposed-blade design.
   3. Galvanized steel.
   4. 0.064 inchthick.
   5. Blade Edging: Closed-cell neoprene edging.
   6. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.

E. Blade Axles: 1/2-inch-diameter; galvanized steel blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.
   1. Operating Temperature Range: From minus 40 to plus 200 deg F.

F. Bearings:
   1. Synthetic.
   2. Dampers in ducts with pressure classes of 3-inch wgor less shall have axles full length of damper blades and bearings at both ends of operating shaft.
   3. Thrust bearings at each end of every blade.

2.3 FLEXIBLE CONNECTORS

A. Materials: Flame-retardant or noncombustible fabrics.

B. Coatings and Adhesives: Comply with UL 181, Class 1.

C. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 incheswide attached to 2 strips of 2-3/4-inch-wide, 0.028-inch-thick, galvanized sheet steel or 0.032-inch-thick aluminum sheets. Provide metal compatible with connected ducts.

D. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
   1. Minimum Weight: 26 oz./sq. yd.
   2. Tensile Strength: 480 lbf/inchin the warp and 360 lbf/inch in the filling.
   3. Service Temperature: Minus 40 to plus 200 deg F.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. Install flexible connectors to connect ducts to equipment.

HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Centrifugal roof ventilators.

1.2 SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:
   1. Certified fan performance curves with system operating conditions indicated.
   2. Certified fan sound-power ratings.
   3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
   4. Material thickness and finishes, including color charts.
   5. Dampers, including housings, linkages, and operators.
   6. Roof curbs.
   7. Fan speed controllers.

B. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.

C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

D. UL Standard: Power ventilators shall comply with UL 705.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver fans as factory-assembled unit, to the extent allowable by shipping limitations, with protective crating and covering.

B. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.

C. Lift and support units with manufacturer's designated lifting or supporting points.

1.5 COORDINATION

A. Coordinate size and location of structural-steel support members.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 CENTRIFUGAL ROOF VENTILATORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
1. Acme Engineering & Mfg. Corp.
2. Carnes Company HVAC.
3. Greenheck.
4. Loren Cook Company.

B. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch-thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inchwood nailer. Size as required to suit roof opening and fan base.
1. Configuration: Self-flashing without a cant strip, with mounting flange.
2. Overall Height: 22 inches.
3. Pitch Mounting: Manufacture curb for roof slope.
4. Metal Liner: Galvanized steel.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install power ventilators level and plumb.

B. Secure roof-mounting fans to roof curbs with cadmium-plated hardware. Refer to Section "Roof Accessories" for installation of roof curbs.

C. Install units with clearances for service and maintenance.

D. Label units according to requirements specified in Section "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

A. Duct installation and connection requirements are specified in other Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section "Air Duct Accessories."

B. Install ducts adjacent to power ventilators to allow service and maintenance.

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

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

3.3 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Refer to Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.

D. Replace fan and motor pulleys as required to achieve design airflow.

E. Lubricate bearings.

PACKAGED OUTDOOR HEATING AND COOLING MAKEUP AIR UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes ventilation and heating makeup air units.

1.2 SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories.

B. Shop Drawings: Include details of installation and wiring diagrams.

C. Startup service reports.

D. Operation and maintenance data.

E. Warranty.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.4 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to replace components listed below that fail in materials or workmanship within specified warranty period.

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:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Greenheck.
2. Captiveaire.
3. Modine.
4. Reznor-Thomas & Betts Corporation; Mechanical Products Division.

2.2 CABINET

A. Construction: Double wall insulated metal cabinet.

B. Exterior Casing: 18 gauge, galvanized (G90) steel with lifting lugs and knockouts for electrical and piping connections.

C. Interior Casing: 24 gauge, galvanized (G90) steel.

D. Base Rails: Galvanized-steel rails for mounting on roof curb.

E. Service Doors: Hinged access doors with neoprene gaskets.

F. Internal Insulation: Fibrous-glass duct lining complying with ASTM C 1071, Type II.
1. Thickness: 1-inch.
2. Insulation Adhesive: Comply with ASTM C 916, Type I.
3. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to casing without damaging liner and without causing air leakage when applied as recommended by manufacturer.

G. Roof Curb: Full-perimeter curb of sheet metal, minimum 12-inch high, with wood nailer, neoprene sealing strip, and welded Z-bar flashing.

2.3 SUPPLY-AIR FAN

A. Fan: Forward-curved centrifugal; statically and dynamically balanced, galvanized steel, mounted on solid-steel shaft with self-aligning, permanently lubricated ball bearings.

B. Motor: Open drip-proof, single-speed motor.

C. Drive: V-belt drive with matching fan pulley and adjustable motor sheaves and belt assembly with minimum 1.4 service factor.

D. Mounting: Fan wheel, motor, and drives shall be mounted in fan casing with elastomeric isolators.

2.4 ELECTRIC HEATING COILS

A. Electric heat: Electric heater is to be UL listed with open coil elements. Heater control cabinet is to be installed within the units heating section. Electric heater is to be provided with SCR controls. Electric heater is to be controlled off of SCR. Units with electric heat are to be provided with a center that shall be constructed to permit single-point high voltage power supply connections.

2.5 OUTDOOR-AIR INTAKE AND DAMPERS

A. Dampers: Leakage rate, according to AMCA 500, shall not exceed 2 percent of air quantity at face velocity of 2000 fpm through damper and pressure differential of 4-inch wg.

B. Damper Operators: Electric.

C. Outdoor-Air Intake Hoods: Galvanized steel, with bird screen and finish to match cabinet.

2.6 FILTERS

A. Comply with NFPA 90A.

B. Cleanable Filters: 2-inch- thick, cleanable metal mesh.

C. Disposable Panel Filters: 2-inch- thick, factory-fabricated, flat-panel-type, disposable air filters with holding frames, with a minimum efficiency report value of 8 according to ASHRAE 52.2 and 90 percent average arrestance according to ASHRAE 52.1.
   1. Media: Interlaced glass fibers sprayed with nonflammable adhesive.
   2. Frame: Galvanized steel.

2.7 CONTROLS

A. Factory-wire connection for controls' power supply.

B. Control devices, including sensors, transmitters, relays, switches, thermostats, humidistats, detectors, operators, actuators, and valves, shall be manufacturer's standard items to accomplish indicated control functions.

C. Unit Controls: Solid-state control board and components with field-adjustable control parameters.

D. Supply-Fan Control: Units shall be electrically interlocked with corresponding louver damper, to operate continuously.

E. Remote-Mounted Status Panel:
   1. Off/Heating Controls: Control operational mode.
   2. Damper Position: Indicates position of outdoor-air dampers in terms of percentage of outdoor air.
   3. Status Lights:
      a. Filter dirty.
      b. Fan operating.
      c. Heating operating.

F. Heating Controls:
   1. Factory-mounted sensor in supply-fan outlet with sensor adjustment located in control panel modulates gas furnace burner to maintain space temperature.
   2. Staged Burner Control: SCR control.

G. Damper Controls: When supply fans stop, close outdoor air intake damper and exhaust louver damper.

2.8 MOTORS

A. Comply with requirements in Section "Common Motor Requirements for HVAC Equipment."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install roof curb on roof structure and secure rooftop replacement-air units on curbs and coordinate roof penetrations and flashing with roof construction.

B. Duct Connections: Duct installation requirements are specified in Section "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply ducts to rooftop replacement-air units with flexible duct connectors. Flexible duct connectors are specified in Section "Air Duct Accessories."

C. Electrical Connections: Comply with requirements in Sections for power wiring, switches, and motor controls.

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

3.2 STARTUP SERVICE

A. Complete installation and startup checks according to manufacturer's written instructions and perform the following:
   1. Inspect for visible damage to electrical heating elements.
   2. Inspect for visible damage to compressor, air-cooled outside coil, and fans.
   3. Inspect casing insulation for integrity, moisture content, and adhesion.
   4. Verify that controls are connected and operable.
   5. Verify bearing lubrication.
   6. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
   7. Adjust fan belts to proper alignment and tension.
   8. Start unit.
   9. Operate unit for run-in period.
   10. Calibrate thermostats.
   11. Adjust and inspect high-temperature limits.
   12. Inspect outdoor-air dampers for proper stroke and interlock with exhaust air louver damper.
   13. Verify operational sequence of controls.

B. After startup and performance testing, change filters, verify bearing lubrication, and adjust belt tension.

C. Remove and replace components that do not pass tests and inspections and retest as specified above.

D. Prepare written report of the results of startup services.

3.3 ADJUSTING

A. Adjust initial temperature and humidity set points.

B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain rooftop replacement-air units. Refer to Section "Demonstration and Training."

CONVECTORS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
1. Electric baseboard radiators.

1.2 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each type of product indicated.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

C. Field quality-control test reports.

D. Operation and maintenance data.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 - PRODUCTS

2.1 ELECTRIC BASEBOARD RADIATORS

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. Berko Electric Heating; a division of Marley Engineered Products.
   2. Chromalox; a division of Emerson Electric Company.
   3. Markel Products; a division of Marley Engineered Products.
   4. Marley Electric Heating; a division of Marley Engineered Products.
   5. Qmark Electric Heating; a division of Marley Engineered Products.

B. Description: Factory-packaged units constructed according to UL 499, UL 1030, and UL 2021.

C. Heating Elements: Nickel-chromium-wire heating element immersed in a heat-transfer liquid and sealed in a heater length copper tube, with high-temperature cutout and sensor running the full length of the element. Element supports shall eliminate thermal expansion noise.

D. Enclosures: Minimum 0.032-inch thick steel.

E. Unit Controls: Integral line-voltage thermostat.

F. Accessories:
   1. Unit mounted, line-voltage thermostat.

PART 3 - EXECUTION

3.1 BASEBOARD RADIATOR INSTALLATION

A. Install units level and plumb.

3.2 CONNECTIONS

A. Ground electric convection heating units according to Section "Grounding and Bonding for Electrical Systems."

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

3.3 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:
   1. Operational Test: After electrical circuitry has been energized, start units to confirm proper convection heating unit operation.
   2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Remove and replace heating units that do not pass tests and inspections and retest as specified above.

MINI-SPLIT HEAT PUMP SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY DESCRIPTION

A. Air conditioning of the control room shall be accomplished by a single, wall mounted fan coil unit with a remote condensing unit installed on the roof.

1.2 QUALITY ASSURANCE

A. The units shall be tested by a Nationally Recognized Testing Laboratory (NRTL), in accordance with ANSI/UL 1995/CAN/CSA-C22.2 No. 236-05 (R2009) Heating and Cooling Equipment and bear the Listed Mark.

B. All wiring shall be in accordance with the National Electric Code (NEC)/Canadian Electrical Code (CEC).

C. The system will be produced in an ISO 9001 and ISO 14001 facility, which are standards set by the International Standard Organization (ISO). The system shall be factory tested for safety and function.

D. The outdoor unit will be factory charged with R-410A.

1.3 DELIVERY, STORAGE AND HANDLING

B. Unit shall be stored and handled according to the manufacturer's recommendations.

PART 2 - WARRANTY

2.1 STANDARD LIMITED WARRANTY

1. This warranty applies to compressor and all parts and is limited in duration to ten (10) years starting from the "installation date" which is one of the two dates below:

    a. The installation date is the date that the unit is originally commissioned, but no later than 18 months after the manufacture date noted on the unit's rating plate.
    b. If the date the unit is originally commissioned cannot be verified, the installation date is three months after manufacture date.

PART 3 – PRODUCTS

4.1 MANUFACTURERS

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

1. Daikin.
2. Mitsubishi.
3. Trane.

2.2 WALL MOUNTED UNIT

A. General: The indoor unit shall be a wall mounted fan coil unit, operable with refrigerant R-410A, equipped with an electronic expansion valve, for installation onto a wall within a conditioned space. Computerized PID control shall be used to control superheat to deliver a comfortable room temperature condition. The unit shall be equipped with a programmed drying mechanism that dehumidifies while limiting changes in room. A mildew-proof polystyrene condensate drain pan and resin net mold resistant filter shall be included as standard equipment. The indoor unit sound pressure shall range from 31 dB(A) to 41 dB(A) at low speed measured at 3.3 feet below and from the unit.

B. Performance: Refer to project plans.

C. Heating and Cooling Outdoor Heat Pump Unit:

1. The outdoor unit shall be completely factory assembled and tested. Included in the unit is factory wiring, piping, control circuit board, fan motor thermal protector, flare connections.
2. Outdoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.
3. Both refrigerant lines shall be entirely insulated from the indoor unit.
4. Safety Devices:
   a. High pressure switch.
   b. Outdoor fan driver overload protector.
   c. Inverter overload protector.
   d. Fusible plugs.
   e. Fuse.
5. Electronic expansion valve.
6. The indoor unit will be separately powered with a 208~230V/1-phase/60Hz.
7. The voltage range will be 253 volts maximum and 187 volts minimum.
8. Ambient Operating Conditions: -5°F heating, 105°F cooling.

D. Indoor Unit:

1. The indoor unit shall be completely factory assembled and tested. Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch. The unit shall have an auto-swing louver which ensures efficient air distribution, which closes automatically when the unit stops. The remote controller shall be able to set five (5) steps of discharge angle. The front grille shall be easily removed for washing. The discharge angle shall automatically set at the same angle as the previous operation upon restart. The drain pipe can be fitted to from either left or right sides.
2. Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.
3. Both refrigerant lines shall be entirely insulated from the outdoor unit.
4. Return air shall be through a resin net mold resistant filter.
5. The indoor units shall be equipped with a condensate pan.
6. The indoor units shall be equipped with a return air thermistor.
7. The indoor unit will be separately powered with a 208~230V/1-phase/60Hz.
8. The voltage range will be 253 volts maximum and 187 volts minimum.

E. Unit Cabinet:

1. The cabinet shall be affixed to a factory supplied wall mounting template and located n the conditioned space.
2. The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.

F. Fan:

1. The fan shall be a direct-drive cross-flow fan, statically and dynamically balanced impeller with high and low fan speeds available.
2. The fan motor shall operate on 208/230 volts, 1 phase, 60 hertz with a motor output range 0.054 to 0.058 HP.
3. The airflow rate shall be available in high and low settings.
4. The fan motor shall be thermally protected.

G. Coil:

1. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.
2. The coil shall be of a waffle louver fin and high heat exchange, rifled bore tube design to ensure highly efficient performance.
3. The coil shall be a 2-row cross fin copper evaporator coil with 14 fpi design completely factory tested.
4. The refrigerant connections shall be flare connections and the condensate will be 11/16 inch outside diameter PVC.
5. A thermistor will be located on the liquid and gas line.
6. A condensate pan shall be located on the unit

H. Electrical:

1. A separate power supply will be required of 208/230 volts, 1 phase, 60 hertz. The acceptable voltage range shall be 187 to 253 volts.
2. Transmission (control) wiring between the indoor and outdoor unit shall be a maximum of 3,280 feet (total 6,560 feet).
3. Transmission (control) wiring between the indoor unit and remote controller shall be a maximum distance of 1,640 feet.

I. Control:

1. The unit shall have controls provided by the unit manufacturer to perform input functions necessary to operate the system including automatic changeover from heating mode to cooling mode.

SUBMERSIBLE MIXED OR AXIAL FLOW PUMPS

PART 1 - GENERAL

1.1 SUMMARY

The Contractor shall furnish and install pumping units and associated pump tubes as hereinafter more particularly specified. The pumping units will serve as replacements for

existing pumps. The existing pumping units and associated pump tubes shall be removed and made available for salvage by the Owner.

1.2 PAYMENT

A. Payment will be made for costs associated with furnishing the pumps as specified. All costs associated with providing the services described within this Specification including removal, testing, installation, and start-up shall be provided within the cost of the pump.

1.3 SUBMITTALS

A. Prior to shipment of the pumping unit the supplier shall electronically submit the following items to the Owner for review:
   1. Product Data:
      a. Preliminary pump curve including flow, head, efficiency, NPSHR, and horsepower for the pump for the range of pump operation. These curves shall document compliance with the performance specifications contained within this specification. Failure to comply with all performance specification could result in rejection of the pump.
      b. Motor characteristic curves or tabulated data (test or calculated) to indicate the speed, power factor, efficiency, current, and kilowatt input, all plotted or tabulated against percent load as abscissas.
      c. Pump construction materials
      d. Detailed drawings including but not limited to the following:
         1) Outline drawings of the pump showing pertinent dimensions and weights.
         2) Cross-sectional drawings of the pump showing each component. Show major or complicated sections of the pump in detail. Indicate on each drawing an itemized list of components showing type, grade, and class of material used and make and model number of standard component used.
      e. Installation and operation manual
   2. Factory Testing Report

   3. Warranties: Include copies of warranties and lists of circumstances and conditions that would affect validity of warranties.

1.4 QUALITY ASSURANCE

A. The pump manufacturer has overall responsibility to supply a complete pumping unit: submersible pump/motor, power and control cables, and related instrumentation and accessories that meet the requirements of this specification and the Drawings. Verification of existing pump station conditions impacting the construction of the pump tube including but not limited to floor opening dimensions, floor elevations, discharge pipe location and elevations is the responsibility of the Contractor/pump manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Furnish pump with lifting lugs or other means to facilitate handling. Design and arrange lugs to allow safe handling of pump during shipping, installation, and maintenance.

B. The pump must be assembled at the manufacturer's plant to assure proper fitting and alignment of all parts. Tolerances cannot exceed those specified or shown on the manufacturing drawings. Check rotating elements for binding.

1.6 WARRANTY

A. The manufacturer of the mixed or axial flow submersible pump must provide a warranty for all equipment furnished under this section against defective workmanship, materials, design, and performance for a period of 3 years from the date of substantial completion. If the equipment or any part thereof does not conform to these warranties, and the Owner so notifies the manufacturer within a reasonable time after its discovery, the manufacturer must thereupon promptly correct such nonconformity by repair or replacement. Coordinate the down time for the equipment with the Owner, and be kept to a minimum duration that is mutually agreed to by the manufacturer and the Owner. The contractor/manufacturer is liable during the warranty period for the direct cost of removal of the equipment from the installed location, transportation to the manufacturer's factory or service shop for repair and return, and reinstallation on site. The manufacturer will be given the opportunity to perform the removal and reinstallation and to select the means of transportation. The expense of removing adjacent apparatus, installing spare equipment, costs of supplying temporary service, is not included in this warranty provision.

B. Pump rehabilitation services shall be covered by a one-year, 100% warranty on all materials and parts modified or replaced on the existing pumps within the rehabilitation services scope. The warranty period shall begin once the pump is delivered to the Owner. The Owner shall be responsible for removal, delivery, and re-installation of the pump during the warranty period.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Pumping Unit Description
1. Each pumping unit includes a pump/motor, power and control cable, lifting chain, and controls. Each pump must be of the vertical, mixed or axial flow submersible type for storm water attached to the same shaft with a submersible electric motor. Except as otherwise stated or noted, the terms pump and pump/motor both refer to a pump/motor integral unit.

2. General Design Requirements
a. Provide the pump meeting head, capacity, speed, efficiency, and range of operation as specified.
b. The pump must, as a minimum, meet the applicable design, materials, and manufacturing requirements of HI 1.3, HI 2.3, HI 9.1-9.5 and these specifications.
c. The pumping unit design and performance must have been demonstrated by previous successful operation of pumps of the required type and of equal design complexity by the manufacturer.
d. The pump must be supplied with a pump tube that is suitable for installation within the existing pump station. The pump shall be self-sealing and self-centering to allow for installation and removal even when the column pipe is

submerged. The pump/motor unit shall be held in place by its own weight and the pumping head.

e. The pump must have a continuously rising head characteristic with decreasing capacity over the required range of operation specified. The pump must not have an unstable operating characteristic over the required range of operation.

f. The pump must be capable of operating in the dry (for the purpose of maintenance and operating checks) for short periods of time as stated in the manufacturer's operating instruction.

g. When operated in the dry, the maximum level of vibration of the assembled pumping unit cannot be greater than the value of the lower limit of the good range of the "General Machinery Vibration Severity Chart". This chart can be obtained from Entek IRD, 1700 Edison Drive, Cincinnati, Ohio 45150. Take measurements at pump operating speed during the Factory Test.

2.2 Pump Performance Requirements

A. Capacities
1. Guaranteed Point: 6,600 GPM at 33.0 TDH with a minimum pump efficiency of 74%
2. Discharge cannot be less than 6,400 gpm against total design head of 35.0 ft.
3. Discharge cannot be less than 8,500 gpm against total design head of 20 ft..

B. Range of Operation
1. The pump must be able to operate at any total dynamic head condition between 15’ and 35.5 TDH’
2. The net positive suction head required (calculated from bottom of pump tube) shall not exceed 34.5’ within the range of operation described above.

C. Efficiencies
1. The pump must have an efficiency of not less than 70% within the range of operation described above.

D. Electric Motor
1. 90 HP, 480V, 3-phase, 3 wire

2.3 Pump Construction

A. General
1. Identify each pump by means of a separate nameplate permanently affixed in a conspicuous location. The plate must bear the manufacturer's name, model designation, serial number if applicable, and other pertinent information such as horsepower, speed, capacity, type, direction of rotation, etc. Make the plate of corrosion-resisting metal with raised or depressed lettering and a contrasting background.

2. Equip each pump with suitably located instruction plates, including any warnings and cautions, describing any special and important procedures to be followed in starting, operating, and servicing the equipment. Make the plates of corrosion-resisting metal with raised or depressed lettering and contrasting background.

B. All the exposed nuts and bolts must be stainless steel. Machine and fit all mating surfaces where watertight sealing is required with nitrile rubber O-rings. The fitting must be such that the sealing is accomplished by metal-metal contact between machined surfaces which results in controlled compression of the O-rings. Sealing compounds, grease, or secondary devices are not acceptable.

C. Material Descriptions
1. Pump Case: Cast Iron, ASTM A48
2. Bellmouth: Cast Iron, ASTM A48
3. Motor Housing: Cast Iron, ASTM A48
4. Impeller: Stainless Steel
5. Pump Shaft: Stainless Steel
6. Casing Wear Ring: Stainless Steel
7. O-Rings: Nitrile Butadiene Rubber (NBR)
8. Fasteners: Stainless Steel
9. Outer Seal Faces: Silicon Carbide / Silicon Carbide
10. Power Cable Jacket: Design for use with submersible pumps
11. Oil (seal lubrication): Ecologically safe, mineral or parifin base
12. Materials Not Specifically Described
    a. Conform materials not specifically described to the latest ASTM specification or to other listed commercial specifications covering class or kinds of materials to be used.

D. Pump Lifting Handle, Lifting Lugs, and Carrier Cable
1. Design the lifting handle to bear the entire weight of the pumping unit at a conservative factor of safety. Provide lifting lugs where the weight of the separate part requires a lug.
2. A stainless steel carrier cable system shall be provided for the proposed pump, to restrain the power and control cables securely during pumping operation. The carrier cable will also be used for installation and removal of the pump thus eliminating any need to enter the discharge column or pump sump. EPDM spacers shall be provided between the power, control, and carrier cable for protection against binding and abrasion. The spacer shall be secured to the power/control/carrier cable bundle with a clamp at regular intervals. Pump Supplier shall supply clamps.

E. Pump and Motor Bearing Arrangement
1. The pump and motor bearings must be the standard design of the manufacturer for the pump supplied under this specification. The type and number must be of proven design as used in previous operating units supplied by the manufacturer. Provide bearings of the grease lubricated and sealed type; having a minimum B-10 bearing life of 50,000 hr. Each bearing must be of the correct design to resist the radial and thrust loads applied. Provide enough bearings to ensure the pump rotating elements are supported so that the possibility of excessive vibration is eliminated. Conform ball and roller bearings life and load ratings to ABMA 9 and ABMA 11.

F. Mechanical Seals

1. Provide a mechanical rotating shaft seal system between the impeller and motor to ensure the motor housing is sealed properly. The mechanical seals must be in tandem, lapped and face type seals running in lubricant reservoirs for cooling and lubrication. The mechanical seals must contain both stationary and rotating tungsten carbide face rings unless otherwise specified. In order to avoid seal failure from sticking, clogging, and misalignment from elements contained in the mixed media, only the seal faces of the outer seal assembly and its retaining clips can be exposed to the mixed media. Contain all other components in the lubricant housing. All seal faces must be solid material capable of being relapped. The seals must require neither maintenance nor adjustment, but be easy to check and replace. Shaft seals without positively driven rotating members are not considered acceptable or equal.

G. Lubricant Housing

1. Provide an oil housing with oil, as recommended by the pump manufacturer, to lubricate the shaft sealing system and to dissipate the heat generated by the motor and bearings.

H. Impeller

1. The impeller design and manufacture must be the manufacturer's standard. The impeller surface must be smooth, without holes and fabrication offsets. The attachments to shaft must be with keys or other fasteners that are made of stainless steel, and of sturdy construction designed to not loosen, but be easily removed for maintenance. The impeller construction may be cast or fabricated. At the time of assembly the impeller clearances must be those shown on assembly drawings and may be checked at the factory. Balance the impeller at the design operating speed. The standard balance quality grade is G6.3 in accordance with ISO 1940-1. Balance in accordance with the procedure in HI 9.6.4, except that a two-plane balance is required. Submit the results of impeller balancing if requested.

I. Shaft

1. The shaft must be one-piece integral with the motor of high-strength cold-rolled stainless steel with a factor of safety of five measured against the ultimate strength. Design the shaft for all torque conditions during normal operation and for runaway speed during reverse flow.

J. Bowl Assembly

1. The bowl assembly may be of cast or fabricated manufacture. The hydraulic design must be the manufacturer's standard design as used in previous operating installations. The general manufacture quality relating to flange design, drilling, bolts, alignments, must be in accordance with industry standard practice.

2.4 Motor

A. The motor must be submersible and conform to the requirements of NEMA MG 1. Size the motor to avoid overload when operating at any point along the characteristic curve of the pump. Provide 3-phase, 60-Hz, 480 V, squirrel cage induction type motors, NEMA

Design B Type. Insulate the stator windings and stator leads with a moisture-resistant Class H insulation with temperature resistance of 180 degrees C, 356 degrees F. Use the service factor of 1.10. The temperature rise above ambient for continuous full load rated conditions and for the class of insulation used cannot exceed the values in NEMA MG 1. The motor must be rated for continuous duty when submerged and also be capable of operation in the dry for short periods of time for testing and maintenance purposes. Motor units and wet well wiring shall be rated for service in hazardous Class 1, Division 2, Group D locations.

B. Torque
   1. Starting torque must be sufficient to start the pump, but in no case less than 60 percent of full-load torque. Break-down torque cannot be less than 150 percent of full-load torque.

C. Support
   1. Provide thrust bearing support of sufficient strength and rigidity to support the weight of the entire rotating element of the motor, pump impeller and shaft, and the hydraulic thrust.

2.5 Cable

A. Specifically design power and instrumentation cable for use with a submersible pump application and conform to the requirements of NEMA WC 70 and NEMA WC 72. Submersible cable suitable for continuous immersion in water at the maximum depth encountered. Cable must have an ampacity of not less than 125 percent of the motor full load current. The cable length shall be sufficient to reach the junction box at the operating level splices.

B. Power and instrumentation cables must enter the motor through a sealing system that prevents water entry into the unit and provides strain relief. The cable entry may be comprised of rubber bushings, flanked by stainless steel washers, having a close tolerance fit against the cable outside diameter and the entry inside diameter for sealing by compression of the bushing, or the entry may be sealed by other gland compression methods.

2.6 Pump Control and Monitoring

Provide a self-contained pump control and monitoring system according to these specifications and the Drawings. Provide independent local indication of the alarm and separate contacts for the remote indication of each alarm and local reset. Sensors must alarm and shut down the pump at an abnormal operating condition. provide separate red alarm indicator lamps and green pump running lamps and label. Provide the following sensors:

1. Temperature Sensor
   a. Temperature sensors in the stator windings to protect the motor against overheating.
   b. Temperature sensors to monitor the main and support bearings.
2. Float Switch Sensor
   a. Float-switch sensor positioned between the bearings and the stator-end coils to detect if liquid penetrates the stator housing.

3. Detectors
   a. A junction box leakage detector and a water-in-oil detector.

2.7 Discharge Tube and Discharge Elbow

A. General

1. Design, manufacture, and install the discharge tube and discharge elbow in accordance with the pump manufacturer's instructions. For purposes of performance and this specification it is treated as part of the pumping unit. Provide the discharge tube of such size to accommodate the dimensions of the pump supplied in accordance with the manufacturer's requirements. Furnish the discharge tube with lifting points to aid in the handling and installation of the tube. Permanently install it in the pump sump as indicated.
2. Design such that the pumps are automatically and firmly connected to the discharge tube when lowered into place and in accordance with the pump manufacturer's instructions. Provide a locking device that prohibits rotational movement of the pump within the tube.
3. The pumps must be easily removable for inspection or service without need to enter the pump sump. The pumps must not require any bolts, nuts, or fasteners for connection to the discharge housing. Provide stiffening, guides, or other features at the pump support to ensure concentric positioning of the pump in the discharge tube. provide means such that an effective seal is obtained between the pump and discharge tube. Power cable penetrations must be watertight.

B. Flanged Joints

Design flanged joints to be airtight and watertight, without the use of preformed gaskets, except that the use of a gasketing compound will be permitted. Mating flanges must be male/female rabbet type or doweled with not less than four tapered dowels equally spaced around the flange. Machine flanges and drill bolt holes concentric with the centerline, having a tolerance of plus or minus 1/4 of the clearance between the bolt and the bolt hole. When fabricated from steel plate, flanges must not be less than 1-1/2 inch thick after machining. Flange machining must not vary more than 10 percent of the greatest flange thickness. Construct fabricated flanges, as a minimum, to the dimensions of AWWA C207, Class B. Connect flanges to the column tube with two continuous fillet welds, one at the inside diameter of flange-to-pump-tube and the other at the outside diameter of pump-tube-to-flange. Weld design is the pump manufacturer's responsibility. Machine mating flanges parallel to a tolerance of 0.002 inch. finish the machine mating flange surface to 125 microns or better.

C. Nuts and Bolts

Use hexagonal type nuts and bolts; with bolts, including assembly, anchor, harness, and dowels of 300 stainless steel. Provide bronze nuts and 300 series stainless steel washers.

D. Bolted Lid

Provide a watertight lid, bolted to the top of the discharge tube.

E. Harnessed Coupling

Provide a flexible mechanical Dresser Couplings style 38, or equivalent to connect the pump discharge elbow to the discharge piping. Install a minimum of four harness bolts (sized by the pump manufacturer) at each coupling.

F. Discharge Piping

Install the discharge piping as indicated. Match the plain end of each discharge pipe to the pump discharge elbow in diameter, and configured to allow a flexible mechanical coupling to connect it to the pump discharge elbow. Terminate the discharge piping in an open end. The discharge pipe must be independently supported and shall not rely on the pump tube for support. Locate the supports between the flexible coupling and the wall, as indicated on the Drawings. The discharge pipe must be non-galvanized piping of welded or seamless pipe or welded steel plate with a minimum thickness of 3/8 inch.

G. Painting

The discharge tube, elbow, and discharge piping shall be blast cleaned per SSPC-SP10, to a near white finish to achieve a surface anchor profile of 1.5 mils. Coat surfaces with (2) two coats of Polyamidoamine Epoxy (Tnemec Series N69 or equivalent) for a total dry mil thickness of 8.0-12.0. Color shall be Black. Apply coatings in accordance with the manufacturer's latest published technical data sheets, application sheets and MSD sheets. Stainless steel or bronze surfaces shall not be painted.

2.8 Factory Tests

A. Performance Test: Test the pump at the manufacturer's shop to demonstrate that the proposed pump operates without instability and complies with specified performance. Instability is defined when any point in the usable range of the head-capacity curve cannot be repeated within 3 percent. When this occurs, rerun the test. Test procedures, except as herein specified, must be in accordance with applicable provisions of HI ANSI/HI 14.6, with an acceptance grade of 1U. Use water for testing at approximately the same temperature for all tests run and record it during test runs.

B. Performance of the Pump: Determine performance of the pump by a series of test points sufficient in number to develop a constant speed curve over the range of total heads corresponding to the performance requirements of this document. The test range must include additional testing at total heads of 2 ft higher than that specified. The lowest total head for testing must be, as a minimum, the total head determined from the referenced paragraph. If the test setup permits testing at lower total heads, extend the range of total heads 2 ft lower. Testing must be inclusive for the speed involved. Test results with this sump elevation must meet all specified conditions of capacity, head, and bhp. Head differentials between adjacent test points cannot exceed 3 ft, but in no case fewer than 10 points be plotted in the pumping range. If the plot of data indicates a possibility of instability or a dip in the head-capacity curve, a sufficient number of additional points on each side of the instability must be made to clearly define the head-capacity characteristics.

C. Test Results: Plot test results to show the total head, static heads, bhp, and efficiency as ordinates. Plot the results against pump discharge in gpm as the abscissa. Plot curves showing pump performance to a scale that will permit reading the head directly to 0.5 ft, capacity to 500 gpm, efficiency to 1 percent, and power input to 5 bhp. Establish that the performance requirements of these specifications and the warranties under this contract have been fulfilled. Perform the performance test with the pump and motor assembled as an operating unit to simulate field installation. Readings must include one point each within 2 percent of the required design points. Conduct the test in accordance with accepted practices at full speed; and, unless otherwise specified, conform to HI ANSI/HI 14.6 procedure and instruments.

PART 3 - EXECUTION

3.1 Installation

A. Install the equipment furnished under this section in accordance with the manufacturer provided Installation and Erection Instructions. The description must be a complete, orderly, step-by-step explanation of operations required, and also include such things as alignment procedures, bolt torque values, permissible blade/bowl clearances; permissible bowl out-of-roundness; recommended instrument setups; recommended gages and instruments; bearing clearances; and similar details. An authorized factory representative must review the pumps in the installed condition and provide written documentation that the installation is in compliance with manufacturer recommendations.

B. Test each pump unit under load, at or near normal operating conditions, for at least (4) four hours or as directed by the Engineer; the test will be witnessed by the Owner and Engineer. Without additional costs to the Owner, make all changes and correct any errors. The Engineer may waive or postpone the test if sufficient water is not available.

C. Provide training to Owner for all Equipment provided under this section.

Method of Measurement: Pump Station Mechanical Work in accordance with this provision will be measured for payment on a lump sum basis.

Basis of Payment: This work will be paid for at the contract unit price per LUMP SUM for PUMP STATION MECHANICAL WORK.

PUMP STATION ELECTRICAL WORK

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Contractor for this work is referred to the Drawings, Bidding Requirements, General Conditions, Special Conditions, Temporary Services and other pertinent Sections of these Specifications. These sections describe work which is a part of this Contract. The following General Provisions amplify and supplement these Sections of Specifications.

1.2 SUMMARY

A. Section Includes:
   1. Electrical equipment coordination and installation.
   2. Common electrical installation requirements.
   3. All removal items associated with Electrical Work

1.3 COORDINATION

A. Contractor must read the entire Specifications covering other branches of Work. Contractor is responsible for coordination of his (her) work with work performed by other trades.

B. Consult all Contract Documents which may affect the location of any equipment or apparatus furnished under this Work and make minor adjustments in location as necessary to secure coordination.

C. System layout is schematic and exact locations shall be determined by structural and other conditions. This shall not be construed to mean that the design of the system may be arbitrarily changed. The equipment layout is to fit into the building as constructed and to coordinate with equipment included under other Divisions of Work.

D. Contractor shall contact the Owner's Representative immediately if he (she) notices any discrepancies or omissions in either the Drawings or Specifications, or if there are any questions regarding the meaning or intent thereof.

E. Submit all changes, other than minor adjustments, to the Engineer for approval before proceeding with the work.

F. The Contractor is required to visit the site and fully familiarize himself or herself concerning all conditions affecting the scope of work. Failure to visit the site shall not relieve the Contractor from any responsibility in the performance of his or her Work.

G. All workmanship to be of the highest quality in accordance with the best practices of the trade by craftsmen/ craftswomen skilled in this particular work.

H. Coordinate arrangement, mounting, and support of electrical equipment:
   1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
   2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
   3. To allow right of way for piping and conduit installed at required slope.
   4. To ensure connecting raceways, cables, wireways, cable trays, and busways are clear of obstructions and of the working and access space of other equipment.

I. Coordinate installation of electrical boxes that are recessed in pre cast wall with precast wall manufacturer. This may require that the electrician be present at the precast wall manufacturer location during the forming of the panels. All costs associated with this coordination shall be included within the bid and no additional time or charges will be allowed to facilitate this coordination.

J. All field holes in precast wall assemblies shall be core drilled holes made in accordance with precast wall manufacturer directions.

K. All buried conduits passing from below the proposed building to the exterior shall pass below the proposed structural footing.

L. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed.

M. Coordinate sleeve selection and application with selection and application of firestopping.

N. Where thermostat locations are shown, the electrical contractor shall provide a recessed wall box with conduit to an accessible location. In areas where surface mounted boxes are required, a surface mounted box and conduit to 10' AFF shall be provided (or to the equipment location, whichever is closer). Thermostat installation and the corresponding low voltage thermostat wiring shall be by the mechanical contractor.

1.4 PERMITS, INSPECTIONS AND CODES

A. File all drawings, pay all fees, and obtain permits and certificate of inspection relative to this Work.

B. Complete installation shall conform with all applicable Federal, State and Local laws, Codes and Ordinances including, but not limited to the latest approved editions of the following:
1. State Building Codes.
2. Specific Construction Safety Requirements, State Industrial Commission.
3. National Electrical Code (NFPA-70).
4. Life Safety Code, NFPA-101.
5. Occupational Safety and Health Act (OSHA) of 1971 and all amendments thereto.

C. Nothing contained in the drawings and specifications shall be construed to conflict with these laws, codes, and ordinances and they are hereby included in these specifications.

1.5 RECORD DRAWINGS

A. Record all deviations from the Drawings, on a set of prints and deliver them to the Owner and Owner's Representative upon completion of the work. Special attention to record the location of concealed boxes, service runs shall be made at the point of installation to maintain accuracy.
1. Sufficient dimensional tie points to permanent building features shall be provided for all buried conduits to facilitate future location.

1.6 INSPECTION

A. Contractor shall arrange for and include in his (her) bid, inspection of this work by the appropriate state or local code authority having jurisdiction.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Furnish new, undeteriorated materials of a quality not less than what is specified.

B. Contractor to furnish and install only those brands of equipment mentioned specifically or accepted as substitutes.

2.2 EQUIPMENT SELECTION AND APPROVAL

A. The selection of materials and equipment to be furnished shall be governed by the following:
   1. Where trade names, brands of manufacturer of equipment or materials are listed in the specification, the exact equipment listed shall be used in the bid or the contractor shall submit the necessary literature to show the alternative product meets the performance characteristics of that which has been called for. Where more than one name is listed, Contractor may select any one of the various brands specified.

2.3 SUBSTITUTIONS

A. Contractor must base his (her) bid on furnishing the brands of material and equipment listed in the Specifications or their approved equals.

B. The Contractor is entitled to bid on any other equal or similar brands of material and equipment he (she) may desire to substitute. In order to be considered, the Contractor must request approval to bid the substitution in writing no later than ten (10) days prior to the Bid Date. If permitted the substitutes will be approved by addendum.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Furnish all materials, labor, tools, transportation, incidentals, and appurtenances to complete in every detail and leave in working order all items of work called for herein or shown on the accompanying Drawings.

B. Include any minor items of work necessary to provide a complete and fully operative electrical system which meets all required codes.

C. Comply with NECA 1.

D. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

E. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

F. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such

a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

G. Right of Way: Give to piping systems installed at a required slope.

3.2 PROTECTION AND CLEANING

A. Protect all fixtures and equipment against damage from leaks or abuse and pay the cost of repair or replacement of fixtures or equipment made necessary by failure to provide suitable safeguards or protection.

B. After all fixtures and equipment have been set, thoroughly clean all fixtures and equipment with manufacturers recommended cleaning agents, removing stickers and other foreign matter and leave every part in acceptable condition, clean and ready for use.

C. Repair all dents and scratches in factory prime or finish coats on all electrical equipment. If damage is excessive, replacement may be required.

LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.

1.2 SUBMITTALS

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

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 STANDARDS

A. Insulation types, ratings and usage shall be in accordance with the National Electrical Code requirements.

B. All conductors shall be copper

C. Unless otherwise noted, minimum wire size for lighting and power branch circuits shall be No. 12 AWG. For control and auxiliary systems, the minimum size shall be No. 14 AWG.

D. Conductors for emergency power and exit wiring shall be a minimum No. 12 AWG.

2.2 CONDUCTORS AND CABLES

A. All wire and cable shall be UL listed.

B. Copper Conductors: Comply with NEMA WC 70.

C. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN, XHHW, and SO.
1. THHN-THWN and XHHW: 90°C temperature rating in dry or wet locations.

D. Multiconductor Cable: Comply with NEMA WC 70 for metal clad cable, Type MC and Type SO with ground wire.

2.3 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

B. All components used at wiring terminations, connections and splices shall be UL listed.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type XHHW single conductors in raceway.

B. Feeders and Branch Circuits: Type THHN-THWN or XHHW single conductors in raceway.

C. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

D. Concealed light fixture whips: Metal clad (Type MC) cable limited to six feet in length.

E. Existing walls and ceilings requiring fishing of cable between access points: Metal clad cable (Type MC).

F. Class 1 Control Circuits: Type THHN-THWN, in raceway.

G. Class 2 Control Circuits: Power-limited cable, concealed in building finishes.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to Sections "Hangers and Supports for Electrical Systems."

F. Identify and color-code conductors and cables according to Section "Identification for Electrical Systems."

G. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

H. Install and make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than un-spliced conductors.
   1. Use oxide inhibitor at each splice, tap conductor and equipment termination for aluminum conductors.

I. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.2 SUMMARY

A. This Section includes methods and materials for grounding systems and equipment.

B. Grounding system shall be in compliance with all requirements of the National Electrical Code.

1.3 SUBMITTALS

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

B. Field Quality Report
   1. Photo Report
   2. Dimensioned as-built locations of grounding features

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:
   1. Solid Conductors: ASTM B 3.
   2. Stranded Conductors: ASTM B 8.
   3. Tinned Conductors: ASTM B 33.
   4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
   5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
   6. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
   7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

2.2 BONDING TERMINATIONS

A. Grounding Bus: Rectangular bars of annealed copper, 1/4 by 2 inches in cross section, unless otherwise indicated; with insulators.

B. Intersystem Bonding Termination:
   1. Lay-in connection clamp sized for connected grounding electrode conductor
   2. Minimum of (5) bonding conductor terminals (#14 AWG- #4 AWG)
   3. UV stabilized base and housing with stainless steel mounting hardware
   4. UL listed as an intersystem bonding termination

2.3 CONNECTORS

A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
   1. Pipe Connectors: Clamp type, sized for pipe.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.4 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 5/8 inch in diameter by 10 feet or as noted on the Drawings.

B. Segmented Ground Rods: Copper-clad steel; 5/8 inch or 3/4 inch in diameter by 10 feet in length, capable of being threaded together to form a continuous vertical grounding electrode as noted on the drawings.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger, unless otherwise indicated.

B. Underground Grounding Conductors: Install bare tinned copper conductor. Bury at least 24 inches below grade.

C. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
1. Install bus on insulated spacers 1 inch, minimum, from wall 6 inches above finished floor, unless otherwise indicated.

D. Conductor Terminations and Connections:
1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Exothermically welded connections except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.2 EQUIPMENT GROUNDING

A. A separate equipment grounding conductor, minimum size per NEC, shall be installed in each feeder, branch circuit, and control circuit conduit. Conductor insulation shall be green. DO NOT use conduit as a means for grounding of receptacles or any other such devices.

B. Conduit system shall be electrically continuous. All enclosures and non-current carrying metals to be grounded. All locknuts must cut through enameled or painted surfaces on enclosures. Where enclosures and non-current carrying metals are isolated from the conduit system, use bonding jumpers with approved clamps.

C. All new receptacles shall be bonded to a ground conductor using a #12 AEG min. bonding jumper between receptacle terminal and ground conductor. Metal-to-metal contact between the device yoke and the outlet box is not acceptable for either surface mounted boxes or flush type boxes.

D. Junction boxes and pull boxes shall be bonded by the use of UL listed ground screws or lugs.

E. Lighting fixtures shall be grounded by the use of a pigtail fastened on bare metal that is free of paint.

F. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

G. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

H. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
   1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch grounding bus.
   2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

I. Metal Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.3 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade, unless otherwise indicated.
   1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.

C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
   1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.

   2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.

   3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.

D. Grounding and Bonding for Piping:
   1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

   2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.

   3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

E. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

3.4 FIELD QUALITY CONTROL

A. Provide a photo report consisting of labeled pictures of all of the following grounding features:
   1. Ground rods
   2. Intersystem bonding termination
   3. Grounding arrangements and connections for separately derived systems
   4. Grounding connection to rebar in footing/floor
   5. Grounding connection to building steel
   6. Grounding connection to metallic water pipe

B. Dimensioned as-built plans showing the locations of the key grounding features contained in the photo report shall be submitted concurrently with the photo report.

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:
   1. Hangers and supports for electrical equipment and systems.

1.2 PERFORMANCE REQUIREMENTS

A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.3 QUALITY ASSURANCE

A. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Aluminum Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Allied Tube & Conduit.
      b. Cooper B-Line, Inc.; a division of Cooper Industries.
      c. ERICO International Corporation.
      d. GS Metals Corp.
      e. Thomas & Betts Corporation.
      f. Unistrut; Tyco International, Ltd.
      g. Wesanco, Inc.
   1. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
   2. Channel Dimensions: Selected for applicable load criteria.

B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
   1. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
   2. See Editing Instruction No. 1 in the Evaluations for cautions about naming manufacturers and products. Retain one of first two subparagraphs and list of manufacturers below.
   3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
   4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.

5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as scheduled in NECA 1, where its Table 1 lists maximum spacings less than stated in NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
1. Secure raceways and cables to these supports with two-bolt conduit clamps.

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.

5. Retain first subparagraph below if powder-actuated devices are allowed. Consider deleting if Project contains both lightweight and standard-weight concrete or more than one thickness of concrete slab.
6. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
7. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
8. To Light Steel: Sheet metal screws.
9. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

B. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
   1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

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

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1.3 SUBMITTALS

A. Product Data: For surface raceways.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

A. Rigid Steel Conduit: ANSI C80.1.

B. PVC Coated Rigid Steel Conduit: UL 6, NEMA RN 1

C. EMT: ANSI C80.3.

D. FMC: Zinc-coated steel.

E. LFMC: Flexible steel conduit with PVC jacket.

F. Fittings for Conduit (Including all types and flexible and liquid-tight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
   1. Fittings for EMT: Steel, set-screw or compression type. Die cast fittings are not acceptable.

G. LFMC: Flexible steel conduit with PVC jacket. Made from a continuous length of galvanized cold rolled steel strip, spirally wound. Adjacent strips shall have locked typed construction with all the edges turned in. With an extruded PVC jacket.

2.2 NONMETALLIC CONDUIT AND TUBING

A. PVC conduit shall be heavy wall, Schedule 40 ultra-violet resistant, UL listed under Standard 651. Conduit shall be suitable for use with 90°C insulated wire. Conduit fittings and cement shall be of the same manufacturer.

B. Fittings for Schedule 40 PVC: Match to conduit or tubing type and material.

2.3 BOXES AND ENCLOSURES

A. Sheet Metal Outlet and Device Boxes: NEMA OS 1,

B. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

C. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

D. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.

2.4 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. Description: Comply with SCTE 77.
   1. Color of Frame and Cover: Green.
   2. Configuration: Units shall be designed for flush burial and have open bottom, unless otherwise indicated.
   3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
   4. Cover Finish: Non-skid finish shall have a minimum coefficient of friction of 0.50.
   5. Cover Legend: Molded lettering, "ELECTRIC.", "TELEPHONE.", “COMMUNICATIONS as appropriate for services contained.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or a combination of the two.

2.5 SLEEVES FOR RACEWAYS

A. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral water stop, unless otherwise indicated.

B. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch thickness as indicated and of length to suit application.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
   1. Above Ground Conduit: Rigid Steel Conduit.
   2. Underground Conduit: Schedule 40 PVC, direct buried.
   3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
   4. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Comply with the following indoor applications, unless otherwise indicated:
   1. All Interior Locations: RMC.
   2. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC
   3. Damp or Wet Locations: RMC.
   4. Raceways for Optical Fiber or Communications Cable: RMC.
   5. Boxes and Enclosures:
      a. Within Control Room Addition: NEMA 250, Type 1.
      b. Within Existing Building: NEMA 250, Type 4X.

C. Minimum Raceway Size: 3/4-inch trade size Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.

3.2 INSTALLATION

A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.

B. Exposed conduits to be run tight to wall or ceiling and installed in a neat workmanlike manner, ready for painting.

C. Install conduit parallel or perpendicular to building lines (except where run in or below floor slabs). Keep conduit runs as closed to underside of structure as possible.

D. Exercise necessary precautions to prevent accumulation of water, dirt, or concrete in conduits during execution of electrical work. Conduit in which water or foreign material has been permitted to accumulate shall be thoroughly cleaned or replaced where such accumulations cannot be removed.

E. Complete raceway installation before starting conductor installation.

F. Support raceways as specified in Section "Hangers and Supports for Electrical Systems."

G. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

H. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.

I. Raceways below slabs:
   1. Minimum conduit size shall be 1”.
   2. Change from PVC conduit to rigid steel conduit before rising above floor.

J. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

K. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 240-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.

L. Raceways for Optical Fiber and Communications Cable: Install as follows:
   1. 3/4-Inch Trade Size and Smaller: Install raceways in maximum lengths of 50 feet.
   2. 1-Inch Trade Size and Larger: Install raceways in maximum lengths of 75 feet.
   3. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless. Separate lengths with pull/junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.

M. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
   1. Where conduits pass from old building to new addition.

2. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
3. Where otherwise required by NFPA 70.

N. Covers for all junction boxes containing emergency circuits shall be red and labeled according to "260553 Identification for Electrical Systems."

O. Flexible Conduit Connections: Use maximum of 72 inches of flexible conduit for recessed and semi-recessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

P. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.
1. Wall boxes in tile, marble, brick or other finished masonry wall shall be of welded construction and designed for installation within masonry.

Q. Weather-proof boxes shall be die cast aluminum.

R. Boxes for exposed work in finished area to be Type FS with threaded hubs and rigid conduit risers.

S. Install expansion fittings at all locations where conduits cross building expansion joints.

T. Secure rigid conduit at cabinets and boxes using insulated throat type grounding and bonding bushings. Locknuts shall be tightened to cut through painted surfaces.

U. Where a number of conduits are to be run exposed and parallel, one with another, they shall be grouped and supported by trapeze hangers or unistrut racks tight to the building structure.

V. Mount junction and pull boxes securely to building structure in a location that meets the requirements of the National Electrical Code for accessibility and work space clearance. Coordinate exact locations of work with other trades. Unless noted otherwise, mounting heights shall be (all measurements are to the top of the box):

Dedicated receptacles (i.e. Control Panels, Motors, etc.)	To suit equipment
Other interior receptacles	16" AFF
Exterior receptacles	20" above finished grade
Other switches	48" AFF
Telephone/data shown next to a doorway	56" AFF
Other telephone/data	16" AFF

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit (not concrete encased):
1. Install direct buried conduit according to requirements for conduit installation.
2. Absent requirements or if the following is more stringent, install direct buried conduit as follows:
a. Excavate by open cut unless otherwise directed on the Drawings.

b. Excavate to the depths necessary to provide at least the NEC required minimum burial depths upon project completion.
c. Over-excavate organic, soft, spongy, or otherwise unsuitable soils found at or below the bottom of the trench as needed to meet firm subsoil.
d. Trenches in non-pavement and non-structure areas:
   1) After installing conduit, backfill and compact utilizing native backfill material. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction leaving a mound on the surface to accommodate future settling.
e. Trenches under pavement or structures and within 5'-0" of same:
   1) After installing conduit, backfill with compacted aggregate to 95% standard proctor density in 8" maximum lifts. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling.

3. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
   a. Couple steel conduits to ducts with adapters designed for this purpose and encase coupling with 3 inches (minimum) of concrete.
   b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.
4. Buried Warning Identification Tape: Provide 6-inch wide plastic detectable tape with foil backing 12 inches minimum below grade, and 12 inches minimum above conduits.

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.

D. CABLE TAGS IN HANDHOLES
1. Provide tags identifying, the origin and destination, for each cable located in each manhole. The tags shall be polyethylene. Do not provide handwritten letters.

3.5 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

B. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

C. Rectangular Sleeve Minimum Metal Thickness:
   1. For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch.
   2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 0.138 inch.

D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

E. Cut sleeves to length for mounting flush with both surfaces of walls.

F. Extend sleeves installed in floors 2 inches above finished floor level.

G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway unless sleeve seal is to be installed.

H. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.

I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint.

J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials.

K. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.

L. Aboveground, Exterior-Wall 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.

3.6 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
1. Identification for conductors and communication and control cable.
2. Data/Telephone outlet labels
3. Receptacle labels
4. Underground-line warning tape.
5. Warning labels and signs.
6. Instruction signs.
7. Equipment identification labels.
8. Miscellaneous identification products.

1.3 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. Comply with 29 CFR 1910.145.

1.4 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

PART 2 - PRODUCTS

2.1 CONDUCTOR, COMMUNICATION, AND CONTROL CABLE IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

B. Marker Tape: Vinyl or vinyl -cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.2 DATA/TELEPHONE OUTLET LABELS

A. Machine printed paper insert with black filled lettering located under clear label cover on face of plate and durable wire markers on inside of outlet box.

2.3 RECEPTACLE LABELS

A. Hot stamped or engraved machine printing with black filled lettering under clear label on face of plate and durable wire markers on inside of outlet box.

2.4 UNDERGROUND-LINE WARNING TAPE

A. Description: Permanent, bright-colored, continuous-printed, polyethylene tape.
1. Not less than 6 inches wide by 4 mils thick.
2. Compounded for permanent direct-burial service.
3. Embedded continuous metallic strip or core.
4. Printed legend shall indicate type of underground line.

2.5 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.

C. Color Scheme
1. Emergency Warning labels: White background with red letters
2. All other warning labels: Yellow background with black letters

D. Warning label and sign shall include, but are not limited to, the following legends:
1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."

2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

3. Service Equipment emergency sources warning: “CAUTION – TWO SOURCES OF SUPPLY- EMERGENCY POWER SOURCE LOCATED IN GENERATOR ROOM 207 ON NORTH SIDE OF BUILDING.”

4. Generator Warning Label: “EMERGENCY GENERATOR”

5. Automatic Transfer Switch Warning Label: “EMERGENCY TRANSFER SWITCH”

6. Emergency Panel Warning Label: “EMERGENCY PANEL”

7. Junction boxes containing emergency circuits: “EMERGENCY CIRCUITS- PANEL *insert name”*

8. As noted on drawings.

2.6 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. in. and 1/8 inch thick for larger sizes.
   1. Engraved legend with black letters on white face. (White letters on red background for emergency information)
   2. Punched or drilled for mechanical fasteners.
   3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.7 EQUIPMENT IDENTIFICATION LABELS

A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for fasteners, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

B. Fasteners for Labels: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

2.8 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

B. Covers for all junction boxes containing emergency circuits shall be red.

PART 3 - EXECUTION

3.1 APPLICATION

A. Auxiliary Electrical Systems Conductor and Cable Identification: Use marker tape to identify field-installed alarm, control, signal, sound, intercommunications, voice, and data wiring connections.
   1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and cable pull points. Identify by system and circuit designation.
   2. Use system of designations that is uniform and consistent with system used by manufacturer for factory-installed connections.

B. Data/Telephone Outlet Identification: Use outlet labels to identify each outlet connection. Use system of designation that is uniform and consistent with cable identification. Label face of plate and wire markers inside of box,

C. Receptacle Identification: Use labels to identify panelboard and circuit number from which served. Label face of plate and wire markers inside of box,

D. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable. Install underground-line warning tape for both direct-buried cables and cables in raceway.

E. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply self-adhesive warning labels. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.

1. Equipment with Multiple Power or Control Sources: Apply to door or cover of equipment including, but not limited to, the following:
   a. Power transfer switches.
   b. Controls with external control power connections.
2. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.

F. Instruction Signs:
1. Emergency Operating Instructions: Install instruction signs with white legend on a red background with minimum 3/8-inch- high letters for emergency instructions at equipment used for emergency shut down of generator or remote operation of main switch.

G. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
1. Labeling Instructions:
   a. Indoor Equipment: Engraved, laminated acrylic or melamine label, drilled for screw attachment. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where 2 lines of text are required, use labels 2 inches high.
   b. Outdoor Equipment: Engraved, laminated acrylic or melamine label, drilled for screw attachment.
   c. Elevated Components: Increase sizes of labels and legend to those appropriate for viewing from the floor.
2. Equipment to Be Labeled:
   a. Panelboards, electrical cabinets, and enclosures.
   b. Electrical switchgear and switchboards.
   c. Transformers.
   d. Generators
   e. Disconnect switches.
   f. Power transfer equipment.
   g. Contactors.
   h. Timeclocks
   i. Fire alarm control panel and annunciators
   j. Motor control switches including Hand/Off/Auto (H-O-A) and Hand/Off (H-O) switches.

3.2 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach non-adhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.

F. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded feeder, and branch-circuit conductors.
   1. Color shall be factory applied or for sizes larger than No. 10 AWG field applied
   2. Colors for 208/120-V Circuits:
      a. Phase A: Black.
      b. Phase B: Red.
      c. Phase C: Blue.
   3. Colors for 480/277-V Circuits:
      a. Phase A: Brown.
      b. Phase B: Orange.
      c. Phase C: Yellow.
   4. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

G. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches overall.

FAULT CURRENT, OVERCURRENT PROTECTIVE DEVICE COORDINATION, AND ARC FLASH HAZARD STUDIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes computer-based, fault-current, overcurrent protective device coordination, and arc flash hazard studies.

B. The fault current study shall be completed prior to ordering equipment to verify the adequacy of the equipment to meet the available fault current conditions.

C. Protective devices shall be set based on results of the protective device coordination study.

D. Arc flash warning labels shall be installed on equipment based on the results of the arc flash hazard study.

1.3 SUBMITTALS

A. Study Reports: Submit (3) hard copies and a digital copy of each report.
   1. Coordination-study input data, including completed computer program input data sheets.
   2. Study and Equipment Evaluation Reports.
   3. Coordination-Study Report.
   4. Arc flash hazard report

1.4 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.

B. Coordination-Study Specialist Qualifications: An entity experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

C. Comply with IEEE 242 for short-circuit currents and coordination time intervals.

D. Comply with IEEE 399 for general study procedures.

E. Comply with IEEE 1584 and NFPA 70E for arc flash hazard calculations

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE PROGRAM REQUIREMENTS

A. Comply with IEEE 399 and IEEE1584.

B. Analytical features of fault-current-study computer software program shall include "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.

PART 3 - EXECUTION

3.1 POWER SYSTEM DATA

A. Gather and tabulate the following input data to support coordination study:
   1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
   2. Impedance of utility service entrance.

3. Electrical Distribution System Diagram: In hard-copy and electronic-copy formats, showing the following:
   a. Circuit-breaker and fuse-current ratings and types.
   b. Relays and associated power and current transformer ratings and ratios.
   c. Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios.
   d. Generator kilovolt amperes, size, voltage, and source impedance.
   e. Cables: Indicate conduit material, sizes of conductors, conductor material, insulation, and length.
   f. Busway ampacity and impedance.
   g. Motor horsepower and code letter designation according to NEMA MG 1.
4. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:
   a. Special load considerations, including starting inrush currents and frequent starting and stopping.
   b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
   c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
   d. Generator thermal-damage curve.
   e. Ratings, types, and settings of utility company's overcurrent protective devices.
   f. Special overcurrent protective device settings or types stipulated by utility company.
   g. Time-current-characteristic curves of devices indicated to be coordinated.
   h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
   i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
   j. Panelboards, switchboards, motor-control center ampacity, and interrupting rating in amperes rms symmetrical.

3.2 FAULT-CURRENT STUDY

A. Calculate the maximum available short-circuit current in amperes rms symmetrical at circuit-breaker positions of the electrical power distribution system. The calculation shall be for a current immediately after initiation and for a three-phase bolted short circuit at each of the following:
   1. Electric utility's supply termination point(s)
   2. Main switchboard(s)
   3. Generators and transfer switche(s)
   4. Distribution panelboard(s)
   5. Branch circuit panelboard(s)
   6. Local motor disconnect(s)

B. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.

C. Calculate momentary and interrupting duties on the basis of maximum available fault current.

D. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with IEEE 241 and IEEE 242.
   1. Transformers:
      a. ANSI C57.12.22.
      b. IEEE C57.12.00.
      c. IEEE C57.96.
   2. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.20.1.
   3. Low-Voltage Fuses: IEEE C37.46.

E. Study Report:
   1. Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram.

F. Equipment Evaluation Report:
   1. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
   2. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
   3. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
   4. Equipment evaluation report shall be completed prior to ordering electrical equipment and devices to ensure that the interrupting ratings of the equipment are sufficient for the available fault currents.

3.3 COORDINATION STUDY

A. Perform coordination study using approved computer software program. Prepare a written report using results of fault-current study. Comply with IEEE 399.
   1. Calculate the maximum and minimum 1/2-cycle short-circuit currents.

B. Comply with IEEE 241 recommendations for fault currents and time intervals.

C. Transformer Primary Overcurrent Protective Devices:
   1. Device shall not operate in response to the following:
      a. Inrush current when first energized.
      b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
      c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
   2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.

D. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time

equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

E. Coordination-Study Report: Prepare a written report indicating the following results of coordination study:
   1. Tabular Format of Settings Selected for Overcurrent Protective Devices:
      a. Device tag.
      b. Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.
      c. Fuse-current rating and type.
   2. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:
      a. Device tag.
      b. Voltage and current ratio for curves.
      c. Three-phase and single-phase damage points for each transformer.
      d. No damage, melting, and clearing curves for fuses.
      e. Cable damage curves.
      f. Transformer inrush points.
      g. Maximum fault-current cutoff point.

F. Completed data sheets for setting of overcurrent protective devices.

3.4 ARC FLASH HAZARD ANALYSIS

A. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2004, Annex D.

B. The flash protection boundary and the incident energy shall be calculated at all equipment locations shown on the one-line diagram.

C. Safe working distances shall be based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm2.

D. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations

E. The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum and will assume a minimum motor contribution (all motors off). Conversely, the maximum calculation will assume a maximum contribution

from the utility and will assume the maximum amount of motors to be operating. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable.

F. The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators should be decremented as follows:

1. Fault contribution from induction motors should not be considered beyond 3-5 cycles.
2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g. contributions from permanent magnet generators will typically decay from 10 per unit to 3 per unit after 10 cycles).

G. For each equipment location with a separately enclosed main device (where there is adequate separation between the line side terminals of the main protective device and the work location), calculations for incident energy and flash protection boundary shall include both the line and load side of the main breaker.

H. When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.

I. Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.

J. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584-2002 section B.1.2. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.

K. Prepare a written report indicating the following results of the incident energy and flash protection boundary calculations including:
1. Arcing fault magnitude
2. Protective device clearing time
3. Duration of arc
4. Arc flash boundary
5. Working distance
6. Incident energy
7. Hazard Risk Category
8. Recommendations for arc flash energy reduction
9. Tabular Format of Settings Selected for Overcurrent Protective Devices:

L. Arc Flash Warning Labels
1. The contractor of the Arc Flash Hazard Analysis shall provide and install a 4 in. x 6 in. thermal transfer type label of high adhesion polyester for each work location analyzed. Label shall be waterproof and UV-resistant.
2. All labels will be based on recommended overcurrent device settings and will be provided after the results of the analysis have been presented to the owner and after any system changes, upgrades or modifications have been incorporated in the system.
3. The label shall include the following information, at a minimum:
   a. Location designation
   b. Nominal system voltage
   c. Arc Flash boundary
   d. Available incident energy and the corresponding working distance
   e. Engineering report number, revision number and issue date.
4. Labels shall be machine printed, with no field markings.
5. One arc flash label shall be provided for each piece of equipment shown on the one-line diagram.

LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes lighting control devices shown on the Drawings.

1.3 SUBMITTALS

A. Product Data: For each scheduled product on the Drawings.

B. Shop Drawings: For each lighting switching schematic shown in the Drawings, provide a separate wiring diagram with wire types, quantities, and devices necessary to provide the functionality indicated on the drawings. Generic wiring diagrams will not be acceptable.

C. Operation and Maintenance Data: Provide (3) hard copies in separate 3-ring binders and an electronic copy. Include the following:
1. Operating Instructions
2. Wiring diagrams
3. As-built settings

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.5 COORDINATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 LIGHTING CONTROL DEVICES

A. See schedule(s) on Drawings

2.2 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section "Low-Voltage Electrical Power Conductors and Cables."

B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Section "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No.14 AWG. Comply with requirements in Section "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

A. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 WIRING INSTALLATION

A. Wiring Method: Comply with Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be 3/4 inch.

B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.3 IDENTIFICATION

A. Identify components and power and control wiring according to Section "Identification for Electrical Systems."
   1. Identify controlled circuits in lighting time switches.

B. Label time switches and contactors with a unique designation.

3.4 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:
   1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.

   2. Operational Test: Verify operation of each lighting control device and adjust time delays.

   3. Owner Training: Contractor shall provide training to owner on lighting device operations and adjustability.

B. Lighting control devices that fail tests and inspections are defective and shall be replaced and re-tested for proper functionality.

LOW VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:
   1. Distribution transformers.

1.3 SUBMITTALS

A. Product Data: For each product indicated.

B. Shop Drawings: Indicate dimensions and weights.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain each transformer type through one source from a single manufacturer.

B. 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.

C. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

1.5 COORDINATION

A. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
1. Eaton Electrical Inc.; Cutler-Hammer Products.
2. General Electric Company.
3. Square D; Schneider Electric.

2.2 GENERAL TRANSFORMER REQUIREMENTS

A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.

B. Cores: Grain-oriented, non-aging silicon steel.

C. Coils: Continuous windings without splices except for taps.
1. Internal Coil Connections: Brazed or pressure type.
2. Coil Material: [Aluminum] [Copper] (use aluminum unless owner design criteria requires copper.)

2.3 DISTRIBUTION TRANSFORMERS

A. Comply with NEMA ST 20 and list and label as complying with UL 1561.

B. Cores: One leg per phase.

C. Enclosure: Ventilated, NEMA 250, Type 2.
1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.

D. Transformer Enclosure Finish: Comply with NEMA 250.
1. Finish Color: Gray.

E. Taps for Transformers Smaller Than 3 kVA: None.

F. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity

G. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.

H. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 150 deg C rise above 40 deg C ambient temperature.

I. Energy Efficiency for Transformers Rated 15 kVA and Larger:
1. Complying with NEMA TP 1, Class 1 efficiency levels.

2. Tested according to NEMA TP 2.

J. Wall Brackets: Manufacturer's standard brackets.

2.4 IDENTIFICATION DEVICES

A. Nameplates: Engraved, laminated-plastic or metal nameplate.

2.5 SOURCE QUALITY CONTROL

A. Test and inspect transformers according to IEEE C57.12.91.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Upon delivery to the project site, inspect transformer(s) in a clean and dry location for damage upon receipt. Note and take photos of any loose or broken connections, damaged or displaced parts, cracked insulators, dirt or foreign material and evidence of free water or moisture. Perform corrective measures as necessary after consulting with the owner and engineer.

B. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.

C. Inspect transformer grounding for compliance with contract drawings and specifications.

D. Inspect anchorage, alignment, grounding and clearances.

E. Mount transformer on concrete slab as follows:
1. Unless otherwise indicated, Concrete Specifications, provide the equipment housekeeping pad at least 4 inches thick, reinforced with #5 reinforcing steel bard 12” on center.
2. Provide edges with ½-inch chamfer.
3. Provide slab of adequate size to project at least 3 inches beyond the equipment.
4. Stub up conduits with bushings, 2 inches into cable wells in the concrete pad. Coordinate exact location of conduit stub ups and grounding conductors with equipment provided.

3.2 CONNECTIONS

A. Comply with NEC 450.10(A), and not installed on or over any vented portion of the enclosure.

3.3 TESTING

A. Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method.

B. Perform specific inspections and mechanical tests as recommended by manufacturer.

C. Verify proper secondary voltage phase-to-phase and phase-to-neutral after energization and prior to loading.

D. Perform resistance measurements through all bolted connections with low-resistance ohmmeter, if applicable.

E. Perform an insulation-resistance test on each arrestor and phase terminal-to-ground.

PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:
1. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.

1.3 SUBMITTALS

A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.
1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types and details for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Retain first subparagraph below if series rating of overcurrent protective devices is used.
6. Include evidence of NRTL listing for series rating of installed devices.
7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
8. Include wiring diagrams for power, signal, and control wiring.
9. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

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. Comply with NEMA PB 1.

D. Comply with NFPA 70.

1.5 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Enclosures: Flush- and surface-mounted cabinets.
   1. Rated for environmental conditions at installed location.
      a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
      b. Outdoor Locations: NEMA 250, Type 3R.
      c. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
      d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
      e. Or as noted on the plans
   2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
   3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
   4. Finishes:
      a. Panels and Trim: Steel and galvanized steel factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
      b. Back Boxes: Galvanized steel.
   5. Directory Card: Provide typewritten circuit directory card inside panelboard door, mounted in transparent card holder.

B. Incoming Mains Location: Top and bottom.

C. Phase, Neutral, and Ground Buses:
   1. Hard-drawn copper, 98 percent conductivity.
   2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.

D. Conductor Connectors: Suitable for use with conductor material and sizes.
   1. Material: Hard-drawn copper, 98 percent conductivity.
   2. Main and Neutral Lugs: Mechanical type.
   3. Ground Lugs and Bus Configured Terminators: Mechanical type.

4. Feed-Through Lugs (When required): Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
5. Subfeed (Double) Lugs (When required): Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

E. Service Equipment Label (When applicable): NRTL labeled for use as service equipment for panelboards with one or more main service disconnecting and overcurrent protective devices.

F. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

G. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.2 DISTRIBUTION PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Square D; a brand of Schneider Electric.

B. Panelboards: NEMA PB 1, power and feeder distribution type.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

D. Mains: Circuit breaker or main lugs only as noted on Drawings.

E. Branch Overcurrent Protective Devices: For Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.

F. Branch Overcurrent Protective Devices: For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

G. Combined Voltage Indicator and Test Station: Provide Grace Engineered Products Model #: P-S13S21-M3RX, or approved equal, voltage test station (VTS) mounted to panel and connected to the (line) incoming conductors per manufacturers recommendations.
1. Operational Voltage Range: 40-600VAC
2. (3) red LEDs for L1, L2 and L3. (1) Green LED for GND.
3. .080 inch diameter pin socket for L1, L2, L3 & GND
4. .480 inch pin insertion length
5. Demonstrate functionality per OSHA and NFPA 70E Article 110.4(A)(5), 120.1 and Annex G.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Square D; a brand of Schneider Electric.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: Circuit breaker or main lugs only as noted on Drawings

D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Square D; a brand of Schneider Electric.

B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

3. AFCI Circuit Breakers: Single pole configurations for 15A and 20A circuits per NFPA 70 Article. 210.12.

4. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
a. Standard frame sizes, trip ratings, and number of poles.
b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
c. Shunt Trip (When indicated): 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.

d. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.

e. Handle Padlocking Device (When indicated): Fixed attachment, for locking circuit-breaker handle in on or off position.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Receive, inspect, handle, store and install panelboards and accessories according to NEMA PB 1.1.

B. Mount top of trim 90 inches Insert height above finished floor unless otherwise required keep the distance from the floor to top most circuit breaker within the height limitation contained in the NEC.

C. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

D. Install overcurrent protective devices and controllers not already factory installed.
   1. Set field-adjustable, circuit-breaker trip ranges.

E. Install filler plates in unused spaces.

F. Recessed panels: Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future.

G. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

H. Comply with NECA 1.

3.2 IDENTIFICATION

A. Create a directory to indicate installed circuit loads and incorporating Owner's final room designations. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

MOTOR CONTROL CENTERS

PART 1 - GENERAL

SUMMARY: This Section includes motor-control centers for use on ac circuits rated 600 V and less.

SUBMITTALS

A. Product Data: For each type of controller and each type of motor-control center. Include dimensions and manufacturer's technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each motor-control center.

   1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:

a. Each installed unit's type and details.
b. Nameplate legends.
c. Short-circuit current ratings of buses and installed units.
d. Vertical and horizontal bus capacities.
e. UL listing for series rating of overcurrent protective devices in combination controllers.
f. Features, characteristics, ratings, and factory settings of each motor-control center unit.

2. Wiring Diagrams: Power, signal, and control wiring for class and type of motor-control center. Provide schematic wiring diagram for each type of controller.

3. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

C. Operation and Maintenance Data: For motor-control centers, all installed devices, and components including the following:

1. Routine maintenance requirements for motor-control centers and all installed components.
2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 50 miles of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.

B. Source Limitations: Obtain motor-control centers and controllers of a single type through one source from a single manufacturer.

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 NFPA 70.

E. Product Selection for Restricted Space: MCC shall be capable of fitting through 36”W x 80”T door.

DELIVERY, STORAGE, AND HANDLING

A. Deliver motor-control centers in shipping splits of lengths that can be moved past obstructions in delivery path as indicated.

B. Handle motor-control centers according to the following:

1. NEMA ICS 2.3, "Instructions for the Handling, Installation, Operation, and Maintenance of Motor Control Centers Rated Not More Than 600 Volts."
2. NECA 402, "Recommended Practice for Installing and Maintaining Motor Control Centers."

COORDINATION

A. Coordinate layout and installation of motor-control centers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate features of motor-control centers, installed units, and accessory devices with pilot devices and control circuits to which they connect.

C. Coordinate features, accessories, and functions of each motor-control center, each controller, and each installed unit with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.

PART 2 - PRODUCTS

MANUFACTURERS

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

1. Eaton Corporation; Cutler-Hammer Products.
2. General Electric Company; GE Industrial Systems.
3. Rockwell Automation; Allen-Bradley Co.; Industrial Control Group.
4. Square D.

MOTOR-CONTROL CENTERS

A. Wiring: NEMA ICS 3, Class Type B.

B. Enclosures: NEMA 250, Type 12.
1. Compartments: Modular; individual doors with concealed hinges and quick-captive screw fasteners. Interlocks on combination controller units requiring disconnecting means in off position before door can be opened or closed, except by operating a permissive release device.
2. Interchangeability: Compartments constructed to allow for removal of units without opening adjacent doors, disconnecting adjacent compartments, or disturbing operation of other units in motor-control center; same size compartments to permit interchangeability and ready rearrangement of units, such as replacing three single units with a unit requiring three spaces, without cutting or welding.
3. Wiring Spaces: Wiring channel in each vertical section for vertical and horizontal wiring to each unit compartment; supports to hold wiring in place.

C. Short-Circuit Current Rating for Each Section: Equal to or greater than indicated available fault current in symmetrical amperes at motor-control center location.

BUSES

A. Material: Plated hard-drawn copper, 98 percent conductivity

B. Ampacity Ratings: As indicated on schedule for horizontal and vertical buses.

C. Neutral Buses: Neutral service conductor termination required. Full length neutral bus not required.

D. Equipment Ground Bus: Noninsulated, horizontal configuration; adequate for equipment ground conductors; bonded to enclosure.

E. Horizontal Bus Arrangement: Main phase and ground buses extended with same capacity the entire length of motor-control center, with provision for future extension at both ends by bolt holes and captive bus splice sections or equivalent.

F. Short-Circuit Withstand Rating: Same as short-circuit current rating of section.

FUNCTIONAL FEATURES

A. Description: Modular arrangement of controllers, control devices, overcurrent protective devices, transformers, panelboards, instruments, indicating panels, blank panels, and other items mounted in compartments of motor-control center.

B. Controller Units: Combination controller units of types and with features, ratings, and circuit assignments indicated.

1. Provide units with short-circuit current ratings equal to or greater than short-circuit current rating of motor-control center section.
2. Equip units in Type B and Type C motor-control centers with pull-apart terminal strips or drawout terminal boards for external control connections.
3. Controller Disconnecting Means: Factory-assembled combination disconnect and controller.

    a. Circuit-Breaker Disconnecting Means: NEMA AB 1, motor-circuit protector with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.

C. Transient Voltage Surge Suppressors: Connect to motor-control center bus
1. Surge Protection Device Description: Non-modular, sine-wave-tracking type with the following features and accessories:

    a. LED indicator lights for power and protection status.
    b. Audible alarm, with silencing switch, to indicate when protection has failed.
    c. Fuses, rated at 200-kA interrupting capacity.
    d. Integral disconnect switch.
    e. Surge-event operations counter.
2. Peak Single-Impulse Surge Current Rating: 160 kA per phase.
3. Connection Means: Permanently wired.
4. UL 1449 latest edition listed.

D. Spaces and Blank Units: Compartments fully bused and equipped with guide rails or equivalent, ready for insertion of future units.

REDUCED VOLTAGE MOTOR STARTER

A. Solid-State, Reduced-Voltage Controller: IEC 60947-4-2, combination soft starter utilizing SCRs for motor soft start/stops, internal run bypass contactors, and solid-state overload protection designed for installation within a motor control center.

1. Soft-start and Soft-stop ramp times shall be independently adjustable
2. Digital Interface Module: LCD display and keypad for viewing and modification of system and control parameters. Digital Interface Module shall be installed in the door of the MCC to allow viewing without opening MCC door. Connection cable shall be long enough to allow for neat and workmanlike cable routing and 180 degree MCC door opening.
3. A minimum of four input contact and two output contacts shall be provided.
4. Control Circuit: 24 VDC. Power supply shall be supplied with controller.
5. Overload Protection: Internal, adjustable solid-state overload protection.
6. Internal start delay timer.
7. Internal protection against phase loss, phase imbalance, phase reversal, shorted SCR, open SCR, low current, and low voltage.
8. Automatic or Manual reset on trip.

FEEDER OVERCURRENT PROTECTION

A. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.

1. Lugs: Mechanical style, suitable for number, size, trip ratings, and material of conductors.

PILOT LIGHTS

A. Push-to-test, oil-tight industrial units utilizing 120 volt bulbs. Lenses shall be colored as shown on the drawings.

ELAPSED TIME METER

A. Heavy duty, electro-mechanical with 6-digit, non-resettable reading in hours and tenths of hours.

MOTOR STARTS COUNTER

A. Electro-mechanical, 6-digit, non-resettable counter.

LABELS/NAMEPLATES

A. All components shall be identified according to wiring diagram.
B. Provide adhesive backed printed labels for all internal devices such as contactors, circuit breakers, and relays. Labels shall be adhered to the back panel. No labels shall be adhered to wire cover.
C. Provide engraved phenolic nameplates, with black letters on white background, for door-mounted devices such as selector switches, push-buttons, circuit breaker toggles, pilot

lights, and equipment name/number of motor controlled. Nameplates shall be secured firmly to the panel.

CONTROL RELAYS

A. General purpose, pin style terminals
B. On/off flag indicator
C. Electrical schematic on face
D. Contact rating: 10A
E. Coil voltage as shown on the Drawings
F. Provide with required mounting base.

FACTORY FINISHES

A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested, motor-control centers before shipping.

PART 3 - EXECUTION

EXAMINATION

A. Examine areas and surfaces to receive motor-control centers for compliance with requirements, installation tolerances, and other conditions affecting performance.

APPLICATIONS

A. Select features of each controller to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; duty cycle of motor, controller, and load; and configuration of pilot device and control circuit affecting controller functions.

B. Select horsepower rating of controllers to suit motor controlled.

INSTALLATION

A. Install motor-control centers on concrete bases.

IDENTIFICATION

A. Each controller shall be labeled with the equipment name and equipment number of the motor controlled.

CONTROL WIRING INSTALLATION

A. Bundle, train, and support wiring in enclosures.

B. Connect hand-off-automatic switch and other automatic-control devices where applicable.
   1. Connect selector switches with motor-control circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

FIELD QUALITY CONTROL

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

1. Perform each electrical test and visual and mechanical inspection, except for optional tests, stated in NETA ATS "Motor Control Centers." Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges.

WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Receptacles, receptacles with integral GFCI, and associated device plates.
   2. Twist-locking receptacles.
   3. Snap switches.
   4. Pendant cord-connector devices.
   5. Cord and plug sets.
   6. Floor service outlets, poke-through assemblies, service poles, and multioutlet assemblies.
   7. Cord reels

1.3 SUBMITTALS

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

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.

B. 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.

C. Comply with NFPA 70.

1.5 COORDINATION

A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
   1. Cord and Plug Sets: Match equipment requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
   1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
   2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
   3. Leviton Mfg. Company Inc. (Leviton).
   4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

2.2 STRAIGHT BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
   1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   2. Products: Subject to compliance with requirements, provide one of the following:
      a. Cooper; 5351 (single), CR5362 (duplex).
      b. Hubbell; HBL5351 (single), CR5352 (duplex).
      c. Leviton; 5891 (single), 5352 (duplex).
      d. Pass & Seymour; 5381 (single), 5352 (duplex).

2.3 GFCI RECEPTACLES

A. General Description: Straight blade, feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
   1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   2. Products: Subject to compliance with requirements, provide one of the following:
      a. Cooper; GF20.
      b. Pass & Seymour; 2084.

2.4 SNAP SWITCHES

A. Comply with NEMA WD 1 and UL 20.

B. Switches, 120/277 V, 20 A:
   1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
      a. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
      b. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
      c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
      d. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).

C. Double-throw, Center-Off Switches (3-Position): 120/277 V, 20 A, HP Rating 1HP- 120V, 2HP-277V

D. Key-Operated Lockable Lighting Switches, 120/277 V, 20 A:
   a. Leviton: 1221-2IL (single pole), 1223-2IL (three way), 1224-2IL (four way)
   b. Hubbell: 4801L (single pole), 4803L (three way), 4804L (four way)
   c. Pass & Seymour; 20AC1-WL (single pole), 20AC2-WL (two pole), 20AC3-WL (three way), 20AC4 (four way).
   d. Cooper: AH1221L (single pole) AH1223L (three way), AH1224L (four way)

2.5 WALL PLATES

A. Single and combination types to match corresponding wiring devices.
   1. Plate-Securing Screws: Metal with head color to match plate finish.
   2. Material for Finished Spaces: Steel with white baked enamel, suitable for field painting
   3. Material for Unfinished Spaces: Galvanized steel.

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, die-cast aluminum with lockable cover.

2.6 HVAC Disconnect Switch

A. Provide local disconnect for all HVAC equipment.

B. 120V Circuits Serving HVAC Equipment
   1. Provide local switch/disconnect via a single pole switch, appropriately rated for the application, housed in a NEMA 1 enclosure equipped lockable meandsimilar

2.7 FINISHES

A. Color: Coordinate with Engineer and Owner
   1. Wiring Devices Connected to Normal Power System: White, unless otherwise indicated or required by NFPA 70 or device listing.
   2. Wiring Devices Connected to Emergency Power System: Red.

PART 3 - EXECUTION

3.1 RECEPTACLE APPLICATION

A. Where required by the most recent version of the NEC and as indicated on the plan sheets: GFCI receptacles

3.2 INSTALLATION

A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.

B. Coordination with Other Trades:
   1. Take steps to ensure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.

2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.

3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.

4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:
   1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.

   2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.

   3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.

   4. Existing Conductors:
      a. Cut back and pigtail or replace all damaged conductors.
      b. Straighten conductors that remain and remove corrosion and foreign matter.
      c. Pigtailing existing conductors is permitted provided the outlet box is large enough.

D. Device Installation:
   1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
   2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.

   3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.

   4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.

   5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.

   6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.

   7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.

   8. Tighten unused terminal screws on the device.

9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:
1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multi-gang wall plates.

H. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.3 IDENTIFICATION

A. Comply with Section "Identification for Electrical Systems."
1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following individually mounted, enclosed switches and circuit breakers:
1. Fusible switches.
2. Nonfusible switches.
3. Enclosures.

1.3 SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.

3. Short-circuit current rating.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

1.5 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 FUSIBLE AND NONFUSIBLE SWITCHES

A. Manufacturers:
1. Eaton Corporation; Cutler-Hammer Products.
2. General Electric Co.; Electrical Distribution & Control Division.
3. Square D/Group Schneider.

B. Fusible Switch, 600 A and Smaller: NEMA KS 1, [480/277V] [208/120V] Type Heavy Duty [two] [three] pole, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept two padlocks interlocked with cover in closed position.

C. Non-fusible Switch, 600 A and Smaller: NEMA KS 1, [480/277V] [208/120V] Type Heavy Duty [two] [three] pole lockable handle with capability to accept two padlocks interlocked with cover in closed position.

D. Accessories:
1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; and labeled for copper and aluminum neutral conductors.

2.3 ENCLOSURES

A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.
1. [Outdoor Locations: NEMA 250, Type 3R]
2. [Outdoor Locations: NEMA [4] [4X]]

3. [Kitchen Areas: NEMA 250, Type 4X, stainless steel.]
4. [Other Wet or Damp Indoor Locations: NEMA 250, Type 4]
5. As noted in the drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.

B. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated. [Anchor floor-mounting switches to raised concrete base/housekeeping pad.]

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

3.2 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs and enclosure nameplates as specified in Section "Identification for Electrical Systems."

3.3 CLEANING

A. On completion of installation, vacuum dirt and debris from interiors; do not use compressed air to assist in cleaning.

B. Inspect exposed surfaces and repair damaged finishes.

ENGINE GENERATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes packaged engine-generator sets for standby power supply with the following features:
1. Diesel engine.
2. Unit-mounted cooling system.
3. Unit-mounted control and monitoring.

B. Related Sections include the following:
1. Section "Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine-generator sets.

1.3 DEFINITIONS

A. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

1.4 SUBMITTALS

A. Product Data: For each type of packaged engine generator indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. In addition, include the following:
   1. Thermal damage curve for generator.
   2. Time-current characteristic curves for generator protective device.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   1. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.
   2. Wiring Diagrams: Power, signal, and control wiring.

C. Source quality-control test reports
   1. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.

D. Field quality-control test reports.

E. Operation and Maintenance Data: Provide (3) hard copies in separate 3-ring binders and an electronic copy. Include the following:
   1. Descriptions: Include the following:
      a. Product name and model number.
      b. Manufacturer's name.
      c. Equipment identification with serial number of each component.
      d. Equipment function.
      e. Operating characteristics.
      f. Limiting conditions.
      g. Performance curves.
      h. Engineering data and tests.
      i. Complete nomenclature and number of replacement parts.
   2. Operating Procedures: Include start-up, break-in, and control procedures; stopping and normal shutdown instructions; routine, normal, seasonal, and weekend operating instructions; and required sequences for electric or electronic systems.
   3. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
   4. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
   5. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including maintenance instructions, drawings and diagrams for maintenance, nomenclature of parts and components, and recommended spare parts for each component part or piece of equipment:

6. Maintenance Procedures: Include test and inspection instructions, troubleshooting guide, disassembly instructions, and adjusting instructions that detail essential maintenance procedures:
7. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
8. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
9. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

F. Fuel Delivery Receipt
1. Proof of fuel delivery with fuel type and quantity indicated

G. Demonstration Training Sign-In Sheet
1. Sign in sheet with all attendee’s signature from demonstration training for Owner

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
1. Maintenance Proximity: Not more than three hours' normal travel time from Installer's place of business to Project site.

B. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 150 milesof Project site, a service center capable of providing training, parts, and emergency maintenance repairs.

C. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with ASME B15.1.

F. Comply with NFPA 37.

G. Comply with NFPA 70.

H. Comply with NFPA 110 requirements for Level 2 emergency power supply system.

I. Comply with UL 2200.

J. Engine Exhaust Emissions: Comply with applicable state and local government requirements.

1.6 PROJECT CONDITIONS

A. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
   1. Ambient Temperature: -15 to 40 deg C.
   2. Relative Humidity: 0 to 95 percent.
   3. Altitude: Sea level to 1000 feet

1.7 COORDINATION

A. Coordinate size and location of concrete bases for package engine generators. Cast anchor-bolt inserts into bases.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Filters: One set each of lubricating oil, fuel, and combustion-air filters.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufactures: Subject to compliance with requirements, provide products by one of the following:
   1. Caterpillar; Engine Div.
   2. Onan/Cummins Power Generation; Industrial Business Group.
   3. HiPower Systems.

2.2 ENGINE-GENERATOR SET

A. Factory-assembled and -tested, engine-generator set.

B. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.
   1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and generator-set center of gravity.

C. Capacities and Characteristics:
   1. Power Output Ratings: Nominal ratings as indicated.
   2. Output Connections: Three-phase, four wire.
   3. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of components.

D. Generator-Set Performance:
   1. Oversizing generator compared with the rated power output of the engine is permissible to meet specified performance.

a. Nameplate Data for Oversized Generator: Show ratings required by the Contract Documents rather than ratings that would normally be applied to generator size installed.

2. Steady-State Voltage Operational Bandwidth: 1 percent of rated output voltage from no load to full load.
3. Transient Voltage Performance: Not more than 10 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within 0.5 second.
4. Steady-State Frequency Operational Bandwidth: Plus or minus 0.25 percent of rated frequency from no load to full load.
5. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
6. Transient Frequency Performance: Less than 2-Hz variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within three seconds.
7. Output Waveform: At no load, harmonic content measured line to neutral shall not exceed 2 percent total with no slot ripple. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
8. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to winding insulation or other generator system components.
9. Excitation System: Performance shall be unaffected by voltage distortion caused by nonlinear load.
   a. Provide permanent magnet excitation for power source to voltage regulator.
10. Start Time: Comply with NFPA 110, Type 10, system requirements.

2.3 ENGINE

A. Fuel: Fuel oil, Grade DF-2

B. Rated Engine Speed: 1800 rpm.

C. Maximum Piston Speed for Four-Cycle Engines: 2250 fpm.

D. Lubrication System: The following items are mounted on engine or skid:
   1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
   2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
   3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.

E. Engine Fuel System:
   1. Main Fuel Pump: Mounted on engine. Pump ensures adequate primary fuel flow under starting and load conditions.
   2. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.

F. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity.

G. Governor: Adjustable isochronous, with speed sensing.

H. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame and integral engine-driven coolant pump.
   1. Coolant: solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
   2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
   3. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
   4. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
   5. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.
      a. Rating: 50-psig (343-kPa) maximum working pressure with coolant at 180 deg F (82 deg C), and noncollapsible under vacuum.
      b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.
   6. Radiator air discharge duct adapter

I. Muffler/Silencer: Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.
   1. Minimum sound attenuation of 25 dB at 500 Hz.
   2. Sound level measured at a distance of 10 feet from exhaust discharge after installation is complete shall be 85 dBA or less.

J. Air-Intake Filter: Heavy-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.

K. Starting System: 12 - V electric, with negative ground.
   1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in Part 1 "Project Conditions" Article.
   2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
   3. Cranking Cycle: As required by NFPA 110 for system level specified.
   4. Battery: Adequate capacity within ambient temperature range specified in Part 1 "Project Conditions" Article to provide specified cranking cycle at least three times without recharging.
   5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
   6. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall be arranged to maintain battery above 10 deg C regardless of external ambient temperature within

range specified in Part 1 "Project Conditions" Article. Include accessories required to support and fasten batteries in place.

7. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.
8. Battery Charger: Current-limiting, automatic-equalizing and float-charging type. Unit shall comply with UL 1236 and include the following features:
   a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
   b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg C to plus 60 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.
   c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
   d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
   e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
   f. Enclosure and Mounting: NEMA 250, Type 1, mounted on generator. Mounting method shall isolate the battery charger from generator-set vibration.

2.4 FUEL OIL STORAGE

A. Comply with NFPA 30.

B. Base-Mounted Fuel Oil Tank: Factory installed and piped, complying with UL 142 fuel oil tank. Features include the following:
   1. Tank level indicator.
   2. Capacity: Fuel for 24 hours' continuous operation at 100 percent rated power output.
   3. Vandal-resistant fill cap.
   4. 24” maximum height of fuel tank
   5. Vent Piping
      a. ASTM A 53, black steel, Schedule 40, Type E or S, Grade B
      b. Wrought-Steel Welding Fittings: ASTM A 234 for butt welding and socket welding
      c. Provide with appropriate caps to prevent rain intrusion
   6. Containment Provisions: Comply with requirements of authorities having jurisdiction.

2.5 EXTERNAL POWER SOURCE

A. All control, monitoring, battery chargers, heaters, etc shall be factory wired and include a single point power connection. Power connection shall be 50 amps, 208V single-phase.

1. If single point wiring is not available from the manufacturer, the Contractor shall be responsible for all field wiring required. All costs and coordination of this work shall be included within the Contractor's bid. No additional time or charges will be allowed to accommodate field wiring.

2.6 CONTROL AND MONITORING

A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.

B. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the generator set. Mounting method shall isolate the control panel from generator-set vibration.

C. Indicating and Protective Devices and Controls: As required by NFPA 110 for Level 2 system, and the following:
1. AC voltmeter.
2. AC ammeter.
3. AC frequency meter.
4. DC voltmeter (alternator battery charging).
5. Engine-coolant temperature gage.
6. Engine lubricating-oil pressure gage.
7. Running-time meter.
8. Ammeter-voltmeter, phase-selector switch(es).
9. Generator-voltage adjusting rheostat.
10. Fuel tank derangement alarm.
11. Fuel tank high-level shutdown of fuel supply alarm.

D. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.

E. Common Remote Audible Alarm: Signal the occurrence of any events listed below without differentiating between event types. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset.
1. Engine high-temperature shutdown.
2. Lube-oil, low-pressure shutdown.
3. Overspeed shutdown.
4. Remote emergency-stop shutdown.
5. Engine high-temperature prealarm.
6. Lube-oil, low-pressure prealarm.
7. Fuel tank, low-fuel level.
8. Low coolant level.

F. Remote Alarm Annunciator: Comply with NFPA 99. An LED labeled with proper alarm conditions shall identify each alarm event and a common audible signal shall sound for each alarm condition. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate are surface- or flush-mounting type to suit mounting conditions indicated.

G. Remote Emergency-Stop Switch: Surface mounted and labeled. Push button shall be protected from accidental operation.

H. Contractor shall provide necessary interconnection wiring as shown on the Drawings to provide for opening of intake louvers (fail open) when the generator is operating.

2.7 GENERATOR OVERCURRENT AND FAULT PROTECTION

A. Provide (2) two identical generator output circuit breakers. One breaker shall be connected to the automatic transfer switch and one breaker shall be reserved for connection of an external load bank.
   1. Breakers shall be interlocked to prevent simultaneous operation.
   2. Provide labels for each breaker.
   3. Protect all lug connections from incidental contact.

B. Generator Circuit Breaker: Molded-case, thermal-magnetic type; 100 percent rated; complying with NEMA AB 1 and UL 489.
   1. Tripping Characteristic: Designed specifically for generator protection.
   2. Trip Rating: Matched to generator rating.
   3. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.
   4. Mounting: Adjacent to or integrated with control and monitoring panel.

2.8 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

A. Comply with NEMA MG 1.

B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.

C. Electrical Insulation: Class H or Class F.

D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.

E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.

F. Enclosure: Drip-proof.

G. Instrument Transformers: Mounted within generator enclosure.

H. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified.

1. Adjusting rheostat on control and monitoring panel shall provide plus or minus 5 percent adjustment of output-voltage operating band.

I. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.

J. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.

K. Subtransient Reactance: 12 percent, maximum.

2.9 FINISHES

A. Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

2.10 SOURCE QUALITY CONTROL

A. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:
1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
2. Full load run.
3. Maximum power.
4. Voltage regulation.
5. Transient and steady-state governing.
6. Single-step load pickup.
7. Safety shutdown.
8. Report factory test results within 10 days of completion of test.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.

B. Examine roughing-in of piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.

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

3.2 INSTALLATION

A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.

B. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.

C. Install exhaust piping with welded joints and connect to engine muffler. Install thimble at wall or roof as shown on the drawings. Piping shall be same diameter as muffler outlet. Connect to generator using flexible connector. Provide rain cap on exhaust termination. Exhaust termination location and height to be in compliance with applicable codes.
   1. Install condensate drain piping to muffler drain outlet full size of drain connection with a shutoff valve, stainless-steel flexible connector, and Schedule 40, black steel pipe with threaded joints.
   2. All interior exhaust piping including the silencer shall be covered with thermal wrap.

D. Install normal and emergency vent piping with welded joints. Allow for disconnection of vent piping from fuel tank via flange connection. Normal and emergency vents shall extend to 24” above roof.

E. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

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

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

H. Fuel tank shall be filled full following all testing requirements and at the time of substantial completion. NO biodiesel shall be used.

3.3 CONNECTIONS

A. Drawings indicate general arrangement of piping and specialties.

B. Connect exhaust-system piping adjacent to packaged engine generator to allow service and maintenance.

C. Connect engine exhaust pipe to engine with flexible connector.

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

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

3.4 IDENTIFICATION

A. Identify system components according to Section "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators.

INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
1. Interior Lighting Fixtures.
2. Exit Signs.
3. Lighting Fixture Support Components.
4. Emergency Lighting

1.3 SUBMITTALS

A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
1. Physical description of lighting fixture including dimensions.
2. Emergency lighting units including battery and charger.
3. Energy-efficiency data.
4. Life, output, and energy-efficiency data for lamps.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

1.5 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. See lighting schedule on Drawings.

2.2 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

B. Metal Parts: Free of burrs and sharp corners and edges.

C. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.

2.3 EXIT SIGNS

A. Description: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:
1. Lamps for AC Operation: LEDs, 70,000 hours minimum rated lamp life.
2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
   a. Battery: Sealed, maintenance-free, nickel-cadmium type.
   b. Charger: Fully automatic, solid-state type with sealed transfer relay.
   c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
   d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
   e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
   f. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and flashing red LED.

2.4 EMERGENCY EGRESS LIGHTING FIXTURES

A. Description: Comply with UL 924. Low profile egress luminaire with (2) LED lamp heads fully adjustable in the horizontal and vertical plane. Housing shall be impact and scratch-resistant, corrosion-proof and capable of being mounted to a universal junction box.

B. Dual voltage (120VAC & 277VAC) compatible.

C. Battery: Sealed maintenance-free nickel-cadmium battery capable of delivering 90 minutes (minimum) of power to emergency lamps. Provide self-diagnostic indicating LEDs and test switch to simulate power loss.

D. Mounting: Ceiling or wall mount standard with flexible conduit entry provisions located on top of unit.

2.5 LIGHTING FIXTURE SUPPORT COMPONENTS

A. Comply with Section "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Support Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gauge.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.

B. Support for Lighting Fixtures in or on Grid-Type Suspended Ceilings: Use grid as a support element.
1. Install a minimum of four ceiling support system rods or wires for each fixture. Locate not more than 6 inches from lighting fixture corners.
2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.

C. Suspended Lighting Fixture Support:
1. Pendants and Rods: Where longer than 48 inchesbrace to limit swinging.
2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
4. Install so the minimum height above finished floor (AFF) is 8’-0” minimum, unless noted otherwise. Supplier shall select and provide suspension hardware as required to comply with this requirement.

D. Adjust aimable lighting fixtures to provide required light intensities.

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

3.2 FIELD QUALITY CONTROL

A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Exterior luminaires.
   2. Poles and accessories.

1.3 SUBMITTALS

A. Product Data: For each luminaire, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:
   1. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.
   2. Details of installation and construction.
   3. Luminaire materials.
   4. Lamps, including life, output, and energy-efficiency data.
   5. Materials, dimensions, and finishes of poles.
   6. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.
   7. Anchor bolts for poles.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store poles on decay-resistant-treated skids at least 12 inchesabove grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.

B. Retain factory-applied pole wrappings on metal poles until right before pole installation. For poles with nonmetallic finishes, handle with web fabric straps.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. See lighting schedule on Drawings.

2.2 LUMINAIRES, GENERAL REQUIREMENTS

A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.

B. Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.

C. Metal Parts: Free of burrs and sharp corners and edges.

D. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.

E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.

F. Exposed Hardware Material: Stainless steel.

G. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

H. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

I. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

2.3 POLES AND SUPPORT COMPONENTS, GENERAL REQUIREMENTS

A. Structural Characteristics: Comply with AASHTO LTS-4.

B. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts, unless otherwise indicated.

C. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.
   1. Materials: Shall not cause galvanic action at contact points.
   2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication, unless stainless-steel items are indicated.
   3. Anchor-Bolt Template: Plywood or steel.

D. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange.

PART 3 - EXECUTION

3.1 LUMINAIRE INSTALLATION

A. Fasten luminaire to indicated structural supports.

B. Adjust luminaires that require field adjustment or aiming.

3.2 POLE INSTALLATION

A. Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on the pole.

B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features, unless otherwise indicated on Drawings:
1. Fire Hydrants and Storm Drainage Piping: 60 inches.
2. Water, Gas, Electric, Communication, and Sewer Lines: 10 feet.
3. Trees: 15 feet.

C. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer.

D. Foundation-Mounted Poles: Mount pole with leveling nuts, and tighten top nuts to torque level recommended by pole manufacturer.
1. Grout void between pole base and foundation. Use nonshrink or expanding concrete grout firmly packed to fill space.
2. Install base covers, unless otherwise indicated.
3. Use a short piece of 1/2-inch- diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.

E. Raise and set poles using web fabric slings (not chain or cable).

3.3 BOLLARD LUMINAIRE INSTALLATION

A. Align units for optimum directional alignment of light distribution.

B. Install on concrete base with top 4 inches above finished grade or surface at bollard location. Cast conduit into base, and shape base to match shape of bollard base. Finish by troweling and rubbing smooth.

3.4 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

B. Steel Conduits: Comply with Section "Raceway and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch-thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.5 GROUNDING

A. Ground metal poles and support structures according to Section "Grounding and Bonding for Electrical Systems."
1. Install grounding electrode for each pole, unless otherwise indicated.
2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

3.6 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.

VIDEO SURVEILLANCE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Security cameras.
2. POE switches.
3. Network video recorder.
4. Security Camera Cable.

1.2 SUBMITTALS

A. Product Data: Submit catalog data showing electrical characteristics and connection requirements for each component.

B. Shop Drawings: Indicate electrical characteristics and connection requirements, including system wiring diagram.

C. Project Record Documents: Record actual locations of cameras and routing of cable.

D. Operation and Maintenance Data: Submit instructions for operating system and performing routine troubleshooting procedures.

E. Warranty documentation.

1.3 QUALITY ASSURANCE

A. NEC 70 National Electric Code

B. NFPA 731 Standard for the Installation of Premises Security Systems.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

B. Installer: Authorized installer of manufacturer with service facilities within 100 milesof Project.

C. Camera system shall not require re-occurring licensing, maintenance, or other fees. A written statement shall be provided with Product Data submittal stating that reoccurring fees are not required.

D. Camera system shall be capable of future expansion. Licensing or other fees shall not be required for system expansion. A written statement shall be provided with the Product Data submittal describing requirements for future expansions.

1.5 EXISTING CONDITIONS

A. Installer shall visit the site to observe any existing conditions that could impact the installation including but not limited to wire routing, camera mounting, and accessibility. Installer shall account for these existing conditions within their bid.

1.6 WARRANTY

A. Furnish a full one-year parts and labor warranty for the system.

B. Provide specific equipment warranties as subsequently described in equipment specifications.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Description: Video surveillance at points as indicated on the Drawings.

2.2 CAMERAS

A. Camera Types: See schedule on Drawings for specific camera information.

B. Acceptable Manufacturers:
1. Avigilon
2. Motorola
3. Genetec
4. Exacq
5. Tyco

C. General:
1. Camera shall be fully compliant with provided digital video recorder but camera/recorder system shall not be a proprietary system that cannot be expanded at a later date.
2. Camera shall be rated for the installed environment (IP-66 rated) (indoor/outdoor).
3. Camera enclosure shall be vandal resistant.
4. Camera enclosure shall be IK-10 impact resistant.
5. Camera shall be capable of streaming 30 fps.
6. Camera shall be ONVIF compliant.
7. PoE capable
8. Two independent IP video streams (dual streaming)
9. Camera shall be capable of day and night operation.
10. Camera shall include integral IR illuminator with minimum 50 ft range.

11. Camera shall include integral motion detection.
12. Camera shall support jpg file image screenshots

2.3 NETWORK VIDEO RECORDER

A. General

B. Single, stand-alone Windows based network video recording system with embedded video management software with a data transfer rate of up to 360 Mbps. Recording system shall be suitable for a camera quantity of at least 120% of the cameras shown on the Drawings. The product shall carry a minimum five (5) year warranty. System shall be capable of storing video data from all cameras shown on the Drawings. Storage capacity shall be calculated by the vendor based on the specified camera resolution, 15 FPS, 30 day storage based with the system set to "Record on Motion" and a 60% motion recording assumption. (Modified via addendum)

1. Acceptable Manufacturers:
   a. Avigilon
   b. Motorola
   c. Genetec
   d. Exacq
   e. Tyco
2. Description:
   a. Video Resolution: HD 1080p.
   b. Number of clients: Unlimited
   c. Network Connections: Dual gigabit Ethernet (RJ-45)
   d. Power Supply: 300W minimum
   e. Storage: 6 TB via up to 3 internal HDD's
   f. System RAM: 8 GB
   g. Video: Onboard with DVI-D or True HD output interface
   h. Additional Interfaces: USB and SD card
   i. Capable of supporting cameras from other manufacturers compliant with ONVIF specifications.

3. Software
   a. Video management system software shall be a software package hosted on the NVR for comprehensive management of live and recorded video, and which supports multiple operating system platforms, mobile client applications, user customization, bandwidth control and scalability. Minimum general functionality includes:
      1) No limitation on the number of cameras supported.
      2) No re-occurring licensing fees or charges to add additional cameras to the system.
      3) Ability to decode H.264 compressed video from multiple manufacturer's cameras, encoders, digital video recorder and network video recorder products.
      4) Seamless transition from live view to recording view
      5) Server and camera configuration from a single window
      6) Ability for a user to log in and view multiple sites based on user permissions and configuration.
      7) On screen PTZ control with programmable presets and tours
      8) Customizable view layouts
      9) E-mapping

10) System server and network health monitoring
11) Definition and display of regions of interest
12) Automatic discovery
    a) Encoder- The internet protocol video management system (IPVMS) shall discover network-connected video encoders and display active channels on the encoder.
    b) Cameras – the IPVMS shall provide a mechanism for automatic camera and server discovery.
        (1) Upon discovery, the IPVMS shall have the ability if selected to:
            (a) Add the device to the system if not previously added.
            (b) Configure optimal image settings for the primary video stream from the device.
    c) Digital video recorder – the IPVMS shall have the ability to discover DVRs connected to the network.
13) Device Management – at a minimum the IPVMS shall provide for management of devices and system functionality as follows:
    a) System configuration tools
        (1) Sort and filter device data
        (2) Rename device
        (3) Add device
        (4) Delete device
        (5) Select and open device
        (6) View device history
        (7) Add video stream from device
        (8) Export device list to file in either HTML or CSV format
        (9) Simultaneous multiple device configuration
    b) Camera and encoder configuration
        (1) Proprietary camera parameters
        (2) Device authentication
        (3) Aspect ratio
        (4) Recording schedule
        (5) Secondary stream quality parameters
        (6) Device authentication
        (7) Image parameters: brightness, contrast, hue, saturation
        (8) PTZ, including home position presets and tours
        (9) Audio recording for audio equipped cameras
        (10) Fish-eye camera properties, including dewarping
    c) Complete listing of all registered devices with device properties
        (1) Manufacturer
        (2) IP address
        (3) Media server device host
        (4) Device name
        (5) Model
        (6) Firmware version
    d) Motion
        (1) Definition of detection areas and areas to exclude from detection.
        (2) Sensitivity.
        (3) Support for both camera hardware and software motion detection.

e) Recording framework
   (1) Recording modes:
      (a) Constant.
      (b) Record on motion.
      (c) Constant low-quality switch to high-quality.
      (d) Do not record.
   (2) Frames per second.
   (3) Recording quality.
   (4) Schedule:
      (a) Hour.
      (b) Day of the week.

14) Review of Video
   a) The IPVMS shall allow the Agency and other partner authorities as specified, viewing of live and recorded video streams on-site only (no network available).
   b) Layout management – local video, cameras and images shall not be restricted in size, location, or orientation.
      (1) Layouts shall support interchangeable backgrounds, including schematic maps and building layouts.
      (2) The IPVMS shall support the construction of customized screen layouts.
      (3) The IPVMS shall allow the creation of up to 64 zoom windows for each camera.
         (a) Camera dewarping shall be employed to correct distortions in fisheye cameras.
      (4) The IPVMS shall support layouts with multiple windows spanning multiple monitors.
      (5) Layout appearances shall be capable of being altered via the following functions:
         (a) Moving and swapping items
         (b) Zoom
         (c) Fit-in view
         (d) Resizing items
      (6) Layouts shall be capable of being assigned to specific tours.
      (7) Layouts shall be capable of being saved or locked to prevent accidental deletion
      (8) The IPVMS shall support camera dewarping on 360 degree and 180 degree fisheye cameras and presentation of 90 degree, 180 degree and 360 degrees on the fly.
   c) Resource management
      (1) In the event of insufficient processing power in the CPU of the client machine, the IPVMS shall automatically adjust the video stream to lower resolution to reduce CPU load.
      (2) The IPVMS shall auto-pause live video during periods of inactivity to conserve bandwidth.
   d) Video playback
      (1) The following playback controls shall be provided:
         (a) Rewind
         (b) Fast rewind at speed up to 16x
         (c) Fast forward

(d) Fast forward at speed up to 16x
(e) Frame by frame advance
(f) Frame by frame reverse
(g) Previous and next recorded fragment
(h) Panning through a timeline using mouse or keyboard shortcuts.

(2) Multiple cameras
(a) Multiple cameras displaying at the same time shall be capable of being synchronized.
(b) The IPVMS shall allow users to navigate multiple cameras.

(3) Permitted users shall be able to seamlessly switch between live and archived video on a camera.

(4) The IPVMS shall allow playback of video files stored local to the client machine.

(5) Available search methods
(a) Time stamp
(b) Calendar date
(c) Motion-highlighted fragments
(d) Thumbnail

e) Video recording
(1) The IPVMS shall be capable of dual stream recording of video from an IP camera with multi-stream capability.
(2) The IPVMS shall provide capability for video recording in the following modes:
(a) Constant
(b) Instant
(c) Upon motion or alarm
(d) Constant low-quality switching to high-quality on motion or alarm
(e) scheduled
(3) The IPVMS shall allow for designation of the recorded video storage based on hard disk or network-based storage configuration.

f) Forensic analysis
(1) The IPVMS shall have the following features to support forensic analysis:
(a) Screen zoom
(b) Full screen mode
(c) Image rotation
(d) Fish-eye camera video and image dewarping
(e) Image enhancement-gamma, black level and white level

15) User Interface (UI) – the UI shall provide the following controls and features:
a) Main Video display view, showing video from all cameras
b) Navigator bar at top of bar that shall include:
(1) Window control
(2) Screen record button
(3) Tabs representing different screen layouts

(4) Resource tree that shows all servers, local files, cameras, users, and available layouts
(5) Date and time
(6) Notification of system events
(7) Playback panel for local stored videos and streams recorded from live video
(8) Main menu which shall include but not be limited to: layout control, screen recording, system settings, server connection, and local video file access.

c) Notifications of system events
d) Resource tree depicting all servers, cameras, users, local files, and optional layouts.
e) Playback panel for local stored videos and streams recorded from live video.

16) Export
a) The IPVMS shall allow the exporting of multiple videos in a format supported by the IPVMS viewer or in a Windows-executable bundle.
(1) All standard IPVMS features, including search, playback and single camera video export shall be useable on a multiple video export.
b) The IPVMS shall allow single camera export, in AVI, executable EXE formats and MKV with time stamps.
c) It shall be possible to create a screen recording from several displays with audio narration and various levels of video quality.
d) IPVMS shall provide watermarking for exported video.
e) Screenshot functionality shall be available for both cameras and local video files in PNG or JPG formats.
f) The IPVMS shall support export to the following sources:
(1) USB flash drive
(2) External hard drive
(3) On-board camera SD card

17) System level features shall include
a) Remote system upgrade with no loss of existing files
b) Set date, time and NTP server synchronization
c) User access control – the IPVMS shall provide user roles as follows:
(1) Administrator: full system control
(2) Advanced viewer: ability to implement configuration, search, view, and export functions as defined by the Administrator.
(3) Viewer: live and playback that is restricted to cameras in assigned layouts.
(4) Live View: live view only with no playback
(5) Custom: rights assigned by Administrator as determined by the Agency.
d) View and export camera settings
e) Firmware upgrade
f) Backup and restoration of system settings
g) Reset to factory default
h) View system logs

i) Ability for system administrators to upgrade an entire system (all servers and clients in a system, regardless of operating system or device type) to a newer version.
j) Automatic system re-indexing upon interruption of storage connection

18) Failover
a) In the event of a storage failure in a cameras SD card, the IPVMS shall allow that camera's video to be temporarily recorded on another camera on the network.
b) Multi-server environment: In the event of a NVR or server failure, when two or more servers are configured in the system, the IPVMS shall provide for migration of camera support to an alternate server and back to the original when restored.

19) Events and Actions
a) The IPVMS shall support the following types of events and actions:
(1) EVENTS
(a) NVR started
(b) Storage failure, NVR is unable to write data to storage.
(c) Motion on camera
(d) Camera disconnection/malfunction
(e) Media server conflict
(f) Email not set for users
(g) Email sending error
(h) Email server not configured
(i) Camera IP address conflict
(j) Storage not configured
(k) NVR failure
(l) Camera alarm input signal
(2) ACTIONS – the IPVMS shall support the creation of rules linking actions to events:
(a) Visual notifications shall be one of the following types: system messages indicating improper configuration, warnings of critical events, non-critical event notification. Additional information concerning a notification shall be available on the user interface by hovering a mouse over the notification.
(b) Visual Event Indication – the IPVMS shall allow the highlighting of a specific object in a scene if too many cameras are opened, creating difficulty in locating a specific camera
(c) Trigger camera output, configurable for duration of event or for a fixed time period. There shall be a configurable auto-reset function for the output when a fixed time period has been selected for output duration.
(d) Play sound – a library of sounds shall be available which shall be capable of having sounds added, edited, or removed. Specific events may be configured to generate specific sounds.

(e) Write to system log – the IPVMS shall be configurable to allow all events with rules to be written to the system log or configurable to allow only certain events to be written to the system log. Logged events shall include date and time of the event, event source, action preformed, recipient of the action, and optional descriptive text. Event logs shall be capable of sorting, filtering and searching.

2.4 POWER OVER ETHERNET SWITCH

A. General
1. Dedicated security camera POE switches shall be supplied and installed in existing 19" IT racks at locations shown on the Drawings.

B. Acceptable Manufacturers:
1. Avigilon
2. Motorola
3. Genetec
4. Exacq
5. Tyco

C. Switch Specifications:
1. Total switch port quantity shall be sufficient to accommodate cameras served by the switch plus a minimum of at least two spare-unused camera ports.
2. One SFP+ port
3. VLAN and QoS capability
4. Remote capability to power cycles per port
5. Power Budget shall be sufficient for all cameras served by the switch plus 20% spare capacity. Additional power budget requirements include:
   a. 16 Port Switch
      1) Minimum total power budget of 230 watts
      2) Maximum of 30 watts per port

2.5 COMMUNICATION CABLE

A. Communication cable for connection of cameras to the POE switch and POE switches to the network video recorder shall be:
1. Category 6A
2. Plenum rated
3. RJ45 end connections
4. Conforming to ANSI/TIA-568-C.2 Category 6A
5. Insulation Color: To be confirmed during shop drawing review from standard insulation colors

B. All security camera communication cables in data cabinets must be terminated in new Panduit Minicom modular patch panels using Panduit Minicom CAT6 snap-in modules. Contractor shall provide new patch panels as required to accommodate security camera cables. Contractor shall provide patch cables to connect patch panels and switches.

PART 3 - EXECUTION

3.1 PREPARATION

A. Video surveillance system vendor/installer shall visit the site to review all existing conditions that could impact the installation of their system and account for these issues within their bid.

3.2 INSTALLATION

A. Installer shall follow all manufacturer published installation, testing, and commissioning procedures and guidelines

B. Installer shall be factory trained and certified to install, service and maintain equipment

C. Install camera specific engraved plastic nameplates on each camera. Nameplate identifier shall match camera identification used in digital video recording software.

D. Video surveillance system vendor/installer shall provide all necessary hardware and mounting brackets to install cameras.

E. Care shall be utilized to prevent damage to existing surface finishes. Surfaces damaged during project installation. Surface damages caused by the installer shall be repaired to pre-project conditions at no cost to the Owner.

F. System cabling shall be routed parallel and/or perpendicular with building lines.

G. System cabling shall be properly supported and shall not be support by the ceiling grid or ceiling tiles.

H. Camera shall be aimed and focused by the installing contractor. Coverage area shall be reviewed with Owner following initial camera aiming prior to final camera adjustment.

3.3 DEMONSTRATION

A. Demonstrate and train Owner's personnel on equipment startup, shutdown, and operation. A minimum of eight hours of training shall be provided.

Method of Measurement: Pump Station Mechanical Work in accordance with this provision will be measured for payment on a lump sum basis.

Basis of Payment: This work will be paid for at the contract unit price per LUMP SUM for PUMP STATION ELECTRICAL WORK.

PUMP STATION GENERAL WORK

Description:

This work shall include all work necessary to construct the new Control Building and rehabilitate the Existing Pump Station building as shown in the plans and specified herein.

The Pump Station General Work Equipment shall include, but not be limited to, the following:

1. Electric Chain Hoists
2. Thermal insulation including perimeter insulation under slabs-on-grade, perimeter foundation wall insulation, concealed building insulation, and related work as shown in the plans.
3. Ethylene propylene diene monomer (epdm) roofing, adhered membrane roofing system, rubber pavers, and related work as shown in the plans.
4. Sheet metal flashing and trim, formed roof drainage sheet metal fabrications and accessories as shown in the plans.
5. Joint sealants for vertical surfaces, interior joints in vertical surfaces and horizontal traffic and non-traffic surfaces as shown in the plans.
6. Fiberglass doors and frames and related work as shown in the plans.
7. Door hardware and accessories as shown in the plans.
8. Toilet Accessories as shown in the plans.
9. Fire Extinguishers and accessories as shown in the plans.
10. Control building furniture, including a desk and chairs

ELECTRIC CHAIN HOISTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Installing a 1/4-Ton Electric Chain Hoists in the existing pump station building.

1.2 REFERENCES

A. Equipment shall meet the requirements of the following specifications unless more stringent requirements are otherwise specified:

1. ANSI B30.16 – Safety Standard for Overhead Hoists.
2. HMI 400 – Standard Specification for Electric Chain Hoists.

1.3 ELECTRIC CHAIN HOIST

A. Capacity of electric chain hoists of 1/4-ton.

B. Hoist shall have lift of 50 ft.

D. Hoist shall include optional chain container.

1.4 SUBMITTALS

A. Shop Drawings: Indicate as a minimum, plans, elevations, layout and sectional views fully dimensioned to indicate actual clearance along with other pertinent data.

B. Panel Layout and Schematic Wiring Diagrams: Provide complete wiring diagrams indicating all electrical devices, numbered terminal strips and wiring and complete description of control system.

C. Catalog data and information shall be submitted for each unit.

1.5 QUALITY ASSURANCE

A. All equipment shall be from one manufacturer or supplier.

B. All materials shall be new and of first class materials and construction.

C. All equipment, including hoists, switches and electrification devices, shall be installed by a manufacturer approved installer to ensure system completeness, operational integrity and safety.

D. Hoist manufacturer shall coordinate and verify compatibility and suitability of existing conditions where indicated on Drawings.

E. Provide a written certification that the equipment has been installed in accordance with the requirements under this Section.

1.6 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of these Special Provisions.

B. Maintenance Data: Include a parts catalog with complete list of equipment replacement parts and local distributors.

C. Operation Manuals: Include description of system's method of operation and control, including motor control system and special or non-standard features provided.

D. Maintenance Manuals: Include instructions for lubrication, adjustment and care of equipment, including detailed technical descriptions of operation, adjustment, and settings of electrical circuits and mechanical equipment.

E. Provide legible schematic wiring diagrams covering electrical equipment as supplied and installed, including changes made in final work, with symbols listed corresponding to identity or markings on equipment.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified with minimum ten years documented experience. The suppliers of equipment under this Section shall be members of the Crane Manufacturer's Association of America, Inc.

B. Installer: Company specializing in performing the work of this section and approved by equipment manufacturer.

1.8 REGULATORY REQUIREMENTS

A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories, Inc., or testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.9 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on shop drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Harrington Hoists and Cranes

B. ACCO/Louden/Wright.

C. R&M Materials Handling Inc.

D. Saturn.

E. North American Industries, Inc.

F. Milwaukee

2.2 GENERAL

A. Service Classifications: All equipment shall be designed for minimum Class C (Moderate Service) as specified in ANSI MH27.1, and outdoor operation in ambient temperatures (-15 degrees to 40 degrees C). Equipment shall be suitable for outdoor storage and usage under varied atmospheric conditions.

B. Classification: ASME H4 and ISO M4

C. The maximum allowable stresses in materials used for various parts of the equipment are specified herein. However, manufacturer shall be responsible for an adequate design based on factors proven in practice and shall use lower working stresses wherever he deems necessary or desirable.

D. Adequate factors of safety shall be used throughout the design, especially in the design of parts subject to alternating stresses, vibration, impact, or shock. Under the most severe conditions of static or dynamic loading expected in normal operation, stresses in the materials shall not exceed the values specified below. Maximum shear stresses in ferrous materials shall not exceed 60% of the allowable stresses in tension, except as noted below. The design stresses for components not listed herein shall be selected by manufacturer, but the maximum stresses in tension or compression shall not exceed one-third of the yield strength nor one-fifth of the ultimate tensile strength.

E. Structural building components as shown on the Drawings are separate from this specification. All other supports, connections, clamps, nuts, washers, etc., are part of this specification.

F. All working parts shall be arranged for convenient inspection, lubrication, adjustment, repair, or replacement. The equipment shall be assembled, painted, tested, and adjusted in the shop as far as practicable before shipment.

2.3 POWER SUPPLY

A. All electric power supply equipment shall be suitable for single phase 120-volt, electric service.

B. Provide power chord on Hoist capable of plugging into a 120 volt single phase outlet.

2.4 ELECTRIC CHAIN HOIST

A. Certified and listed to UL 1340

B. Electric hoist controls shall comply with N.E.C. requirements for the application being considered and shall include control fusing and contacts mechanically and electrically interlocked.

C. Hoist and appurtenances shall be designed to withstand all stresses imposed under safe operating conditions while handling loads within the rated capacity.

D. Load bearing parts shall be designed such that the static stress, calculated for rated load, shall not exceed 20% of the ultimate strength of the material.

E. Furnish suitable push-button pendant control. Push-button arrangement to be supplied with strain relief protection.

F. Hooks shall be supported by anti-friction thrust bearings and permit 360° rotation. Provide latch to bridge opening of the hook.

G. Hoists shall be equipped with overload limit device to limit loads to rated capacity.

H. Provide an upper limit switch which will automatically stop the hoist motion when the block reaches its highest position.

I. The braking system shall be capable under normal operating conditions with rated load to stop and hold the load when controls are released. Two brakes shall be provided; Mechanical load brake and electrical motor brake.

J. Controlled lowering shall be limited to 120% of rated lowering speed. In the event of complete power failure, the load shall be stopped and held.

K. All bearings shall be heavy duty, anti-friction type with a minimum B10 life of 5,000 hours.

L. All gearing shall be forged heat treated alloy steel machined for smooth quiet operation. All gearing shall meet AGMA quality specifications. No cast gears shall be permitted.

M. Chain Hoists shall have chains that are Grade 80, super strength, nickelplated load chain, certified to DIN standards, resistance to fatigue and wear.

N. A notched hook and latch system shall provide positive closing and resistance against lateral forces.

O. Chain containers shall be made of canvas, plastic, or steel, as determined by hoist manufacturer.

2.5 FINISHES

A. All material shall be cleaned of loose rust, mill scale and foreign matter.

B. Equipment shall be painted with the manufacturer's standard finish, suitable for weather exposure.

C. Equipment must be adequately protected against damage and rust in shipment

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that electrical power is available and of correct characteristics.

3.3 INSTALLATION

A. Install system and components in accordance with ANSI B30.11

B. Structural members shall not be cut, drilled or otherwise altered without permission of the Engineer.

C. Structural supports as shown on the Drawings are separate from this specification. All other supports, connections, clamps, nuts, washers, etc., are part of this specification.

3.4 TEST BY REGULATORY AGENCIES

A. Perform tests required by ANSI B30.11 and ANSI B30.2.0 in the presence of the Engineer and Department. Hoist shall be tested through a complete lift and lowering cycle to determine that the equipment will perform the function of hoisting, braking and traveling quietly and smoothly. The hoisting capacity shall be tested as near actual anticipated loads as possible with available loading facilities such as material or equipment which is readily available within area served. Defects in the equipment indicated by tests shall be promptly corrected.

B. Schedule tests with two week notice.

C. Remove protective coverings from protected surfaces.

D. Clean surfaces and components ready for inspection.

THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following1. Concealed building insulation.

1.2 SUBMITTALS

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

B. Samples for Verification: Full-size units for each type of exposed insulation indicated.

PART 2 - PRODUCTS

2.1 FOAM-PLASTIC BOARD INSULATION

A. Extruded-Polystyrene Board Insulation: ASTM C 578, Type X, 1.30 lb/cu. ft. with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively:

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice, rain, and snow.

C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. For preformed insulating units, provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.2 INSTALLATION OF PERIMETER AND UNDER-SLAB INSULATION

A. On vertical surfaces, set insulation units in adhesive applied according to manufacturer's written instructions. Use adhesive recommended by insulation manufacturer.

B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

C. Protect below-grade insulation on vertical surfaces from damage during backfilling by applying protection course with joints butted. Set in adhesive according to insulation manufacturer's written instructions.

D. Protect top surface of horizontal insulation from damage during concrete work by applying protection course with joints butted.

3.3 INSTALLATION OF GENERAL BUILDING INSULATION

A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

B. Seal joints between foam-plastic insulation units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.

ETHYLENE PROPYLENE DIENE MONOMER (EPDM) ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes adhered membrane roofing system and rubber pavers.

1.2 SUBMITTALS

A. Product Data: For each product indicated.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other Work.

C. Samples: For each product included in membrane roofing system.

D. Maintenance data.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's warranty.

B. Source Limitations: Obtain components for membrane roofing system from same manufacturer as roofing membrane.

1.4 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.5 WARRANTY

A. Special Warranty: Manufacturer's total system warranty form, without monetary limitation, in which manufacturer agrees to repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period. Failure includes roof leaks.

1. Warranty Period: 55 mph, 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 EPDM ROOFING MEMBRANE

A. EPDM Roofing Membrane: ASTM D 4637, Type II, scrim or fabric internally reinforced uniform, flexible sheet made from EPDM, and as follows:

1. Thickness: 60 mils, nominal.

2. Exposed Face Color: Black.

2.2 AUXILIARY MATERIALS

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with membrane roofing.

B. Sheet Flashing: 60-mil- thick EPDM, partially cured or cured, according to application.

C. Bonding Adhesive: Manufacturer's standard bonding adhesive.

D. Seaming Material: Single-component butyl splicing adhesive and splice cleaner

E. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening membrane to substrate, and acceptable to membrane roofing system manufacturer.

F. Miscellaneous Accessories: Provide lap sealant, water cutoff mastic, metal termination bars, metal battens, pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, in-seam sealants, termination reglets, cover strips, and other accessories.

2.3 ROOF INSULATION

A. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, felt or glass-fiber mat facer on both major surfaces.

1. Refer to drawings – insulation to be mechanically fastened to metal deck of existing well house. Insulation will be fully adhered to concrete deck of new pump house.

B. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches, unless otherwise indicated.

C. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

2.4 INSULATION ACCESSORIES

A. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.

B. Cold Fluid-Applied Adhesive: Manufacturer's standard cold fluid-applied adhesive formulated to adhere roof insulation to substrate.

2.5 PREFINISHED METAL ROOF EDGE

A. Anchor bar roof edge fascia system consisting of heavy .100" thick extruded aluminum bar, corrosion resistant stainless steel fasteners, and snap-on 24 ga. prefinished fascia cover.

PART 3 - EXECUTION

3.1 INSULATION INSTALLATION

A. Coordinate installing membrane roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.

B. Comply with membrane roofing system manufacturer's written instructions for installing roof insulation.

C. Install tapered insulation under area of roofing to conform to slopes indicated.

D. Install one or more layers of insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2 inches or greater, install 2 or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches in each direction.

E. Adhered Insulation: Install each layer of insulation and adhere to substrate as follows:

1. Set each layer of insulation in a cold fluid-applied adhesive.

F. Mechanically Fastened Insulation: Install each layer of insulation and secure to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.

1. Fasten insulation to resist uplift pressure at corners, perimeter, and field of roof.

3.2 ADHERED ROOFING MEMBRANE INSTALLATION

A. Install roofing membrane over area to receive roofing according to membrane roofing system manufacturer's written instructions. Unroll roofing membrane and allow to relax before installing.

B. Accurately align roofing membrane and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

C. Bonding Adhesive: Apply bonding adhesive to substrate and underside of roofing membrane at rate required by manufacturer and allow to partially dry. Do not apply bonding adhesive to splice area of roofing membrane.

D. Mechanically or adhesively fasten roofing membrane securely at terminations, penetrations, and perimeter of roofing.

E. Adhesive Seam Installation: Clean both faces of splice areas, apply splicing cement, and firmly roll side and end laps of overlapping roofing membranes according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of roofing membrane terminations.

F. Repair tears, voids, and lapped seams in roofing that does not meet requirements.

3.3 BASE FLASHING INSTALLATION

A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions.

B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply bonding adhesive to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

D. Clean splice areas, apply splicing cement, and firmly roll side and end laps of overlapping sheets to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of sheet flashing terminations.

E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.4 FIELD QUALITY CONTROL

A. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion and submit report to Engineer.

B. Repair or remove and replace components of membrane roofing system where test results or inspections indicate that they do not comply with specified requirements.

SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Formed roof drainage sheet metal fabrications.

2. Formed low-slope roof sheet metal fabrications (shop-built roof hatches at Existing Pump Station Building).

1.2 SUBMITTALS

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

B. Shop Drawings: Show installation layouts of sheet metal flashing and trim, including plans, elevations, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work.

1. Include details for forming, joining, supporting, and securing sheet metal flashing and trim, including pattern of seams, termination points, fixed points, expansion joints, expansion-joint covers, edge conditions, special conditions, and connections to adjoining work.

C. Samples: For each exposed product and for each finish specified.

D. Maintenance data.

E. Warranty: Sample of special warranty.

1.3 QUALITY ASSURANCE

A. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or shown on Drawings.

1.4 WARRANTY

A. Special Warranty on Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SHEET METALS

A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping.

B. Aluminum Sheet: ASTM B 209, alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required.

1. Exposed Coil-Coated Finishes:

a. Two-Coat Fluoropolymer: AAMA 620. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat.

2. Color: As selected by Owner from manufacturer's full range.

C. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304, dead soft, fully annealed; 2D (dull, cold rolled) finish.

D. Metallic-Coated Steel Sheet: Restricted flatness steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.

1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 coating designation; structural quality.

2. Exposed Coil-Coated Finish:

a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat.

3. Color: As selected by Owner from manufacturer's full range.

2.2 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.

1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.

a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating.
b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.

2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.

3. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.

4. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329 or Series 300 stainless steel.

C. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.

D. Elastomeric Sealant: ASTM C 920, elastomeric polymer sealant; low modulus; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

E. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

F. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.

G. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.3 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, geometry, metal thickness, and other characteristics of item indicated. Fabricate items at the shop to greatest extent possible.

1. Obtain field measurements for accurate fit before shop fabrication.

2. Form sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.

3. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces exposed to view.

B. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant.

C. Expansion Provisions: Where lapped expansion provisions cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.

D. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

E. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.

F. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints where necessary for strength.

2.5 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Roof-Penetration Flashing: Refer to drawings for fabrication details of shop-built roof hatches at Existing Pump Station Building. Fabricate from the following materials:

1. Stainless Steel: Type 304, 0.0785 inch thick (14 ga.)

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement so that completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.

2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.

3. Space cleats not more than 12 inches apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.

4. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.

5. Install sealant tape where indicated.

6. Torch cutting of sheet metal flashing and trim is not permitted.

B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by SMACNA.

1. Coat back side of uncoated aluminum and stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.

2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet or install a course of polyethylene sheet.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.

D. Fastener Sizes: Use fasteners of sizes that will penetrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Seal joints as shown and as required for watertight construction.

F. Rivets: Rivet joints in uncoated aluminum where indicated and where necessary for strength.

3.2 ROOF DRAINAGE SYSTEM INSTALLATION

A. General: Install sheet metal roof drainage items to produce complete roof drainage system according to SMACNA recommendations and as indicated. Coordinate installation of roof perimeter flashing with installation of roof drainage system.

3.3 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder and sealants.

C. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.

JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes joint sealants for the following applications, including those specified by reference to this Section:

1. Exterior joints in vertical surfaces.
2. Interior joints in vertical surfaces and horizontal nontraffic surfaces.
3. Interior joints in horizontal traffic surfaces.

B. See Division 08 Section "Glazing" for glazing sealants.

1.2 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

1.3 PERFORMANCE REQUIREMENTS

A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

1.4 WARRANTY

A. Special Installer's Warranty: Installer's standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.

B. VOC Content of Interior Sealants: Provide interior sealants and sealant primers that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Sealants: 250 g/L.
2. Sealant Primers for Nonporous Substrates: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.

C. Colors of Exposed Joint Sealants: As selected by Owner from manufacturer's full range.

2.2 ELASTOMERIC JOINT SEALANTS

A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

B. Stain-Test-Response Characteristics: Where elastomeric sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

C. Suitability for Immersion in Liquids. Where elastomeric sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247 and qualify for the length of

exposure indicated by reference to ASTM C 920 for Class 1 or 2. Liquid used for testing sealants is deionized water, unless otherwise indicated.

D. Single-Component Neutral- and Basic-Curing Silicone Sealant:

1. Type and Grade: S (single component) and NS (nonsag).
2. Class: 100/50.
3. Use Related to Exposure: NT (nontraffic).
4. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
5. Stain-Test-Response Characteristics: Nonstaining to porous substrates per ASTM C 1248.

E. Single-Component Neutral-Curing Silicone Sealant:

1. Type and Grade: S (single component) and NS (nonsag).
2. Class: 25.
3. Use Related to Exposure: NT (nontraffic).
4. Uses Related to Joint Substrates: G, A, and, as applicable to joint substrates indicated, O.

F. Single-Component Mildew-Resistant Neutral-Curing Silicone Sealant:

1. Type and Grade: S (single component) and NS (nonsag).
2. Class: 25.
3. Use Related to Exposure: NT (nontraffic).
4. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.

G. Single-Component Nonsag Urethane Sealant:

1. Type and Grade: S (single component) and NS (nonsag).
2. Class: 25.
3. Uses Related to Exposure: T (traffic) and NT (nontraffic).
4. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.

H. Multicomponent Nonsag Immersible Urethane Sealant:

1. Type and Grade: M (multicomponent) and P (pourable).
2. Class: 50.
3. Uses Related to Exposure: NT (nontraffic) and I (immersible), Class 1.
4. Uses Related to Joint Substrates: M, A, and, as applicable to joint substrates indicated, O.

I. Single-Component Pourable Urethane Sealant:

1. Type and Grade: S (single component) and P (pourable).
2. Class: 25.
3. Uses Related to Exposure: T (traffic) and NT (nontraffic).

4. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.

2.3 SOLVENT-RELEASE JOINT SEALANTS

A. Pigmented Narrow-Joint Sealant: Manufacturer's standard, solvent-release-curing, pigmented, synthetic-rubber sealant complying with AAMA 803.3 and formulated for sealing joints 3/16 inch or smaller in width.

2.4 LATEX JOINT SEALANTS

A. Latex Sealant: Comply with ASTM C 834, Type O P, Grade NF.

2.5 JOINT-SEALANT BACKING

A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, Type [C (closed-cell material with a surface skin)] [O (open-cell material)] [B (bicellular material with a surface skin)] [or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated], and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:

C. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 26°F. Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and to otherwise contribute to optimum sealant performance.

D. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.6 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

EXECUTION

3.1 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants.

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant.

a. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air.

2. Remove laitance and form-release agents from concrete.

a. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.

B. Joint Priming: Prime joint substrates, where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.2 INSTALLATION

A. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

B. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.

2. Do not stretch, twist, puncture, or tear sealant backings.

3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

C. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.

2. Completely fill recesses in each joint configuration.

3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.

2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.

3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.

F. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.3 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior vertical and horizontal nontraffic construction joints in cast-in-place concrete and stone.

1. Joint Sealant: Single-component nonsag urethane sealant.

B. Joint-Sealant Application: Exterior vertical control and expansion joints in unit masonry.

1. Joint Sealant: Single-component nonsag urethane sealant

C. Joint-Sealant Application: Exterior perimeter joints between masonry and frames of doors and louvers.

1. Joint Sealant: Single-component nonsag urethane sealant

D. Joint-Sealant Application: Vertical control and expansion joints on exposed interior surfaces of exterior walls.

1. Joint Sealant: Single-component neutral- and basic-curing silicone sealant

E. Joint-Sealant Application: Interior perimeter joints of exterior openings.

1. Joint Sealant: Single-component nonsag polysulfide sealant

F. Joint-Sealant Application: Interior joints between plumbing fixtures and adjoining walls, floors, and counters.

1. Joint Sealant: Single-component mildew-resistant neutral-curing silicone sealant

G. Joint-Sealant Application: Vertical joints on exposed surfaces of interior unit masonry walls and partitions.

1. Joint Sealant: Single-component neutral- and basic-curing silicone sealant

H. Joint-Sealant Application: Perimeter joints between interior wall surfaces and frames of interior doors.

1. Joint Sealant: Latex sealant.

FIBERGLASS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Standards for manufacturing, machining, finishing and installation of heavy-duty insulated fiberglass reinforced polymer doors and fiberglass reinforced polymer frames unless more specifically described under other section(s).

1.2 SUBMITTALS

A. Shop Drawings

1. Shop and erection drawings of all fabricated and milled items.

1.3 QUALITY ASSURANCE

A. Provide doors and frames meeting or exceeding the minimum standards as set forth by the following organizations unless standards are modified or exceeded by this specification:

1. Composite Fabricators Association (CFA).

2. Composites Institute

B. All doors and frames shall be the products of the same manufacturer to insure uniformity of quality and appearance throughout the project.

C. The top of each door shall bear a bar code label from the manufacturer indicating the door serial number, date(s) of manufacture, size and type.

D. The door manufacturer shall provide a Certification of Compliance with this specification signed by an authorized company representative.

1.4 DELIVERY AND STORAGE

A. Deliver all materials to job site and store in a manner to prevent damage.

1.5 WARRANTY

A. To include (10) years free from defects in material and workmanship from date of shipment.

B. Lifetime from corrosion provided that door panels and frames have not been compromised.

PART 2 - PRODUCTS

2.1 MATERIALS AND COMPONENTS

A. Door Core

1. Cores shall be injected, closed cell, polystyrene foam with a density of 4 pounds per square foot. Foam shall be injected into the door cavity while the door is in a press. Foam shall be allowed to cure in place prior to door being removed from the press. The use of drop in foam cores shall be prohibited.

B. Door Stiles, Rails and Stiffeners

1. Stiles and rails shall be tubular fiberglass members and manufactured by the pultrusion process. Outside dimensions shall conform to hardware reinforcement requirements and overall door thickness of 1.75 inches. Vertical stiffeners shall be minimum 6” o.c. Resin and reinforcement selection shall be compatible with door facing material.

C. Door Face Skins

1. Door face skins shall consist of a Fiberglass Laminate manufactured by the Resin Transfer Molding (RTM) process. Skin thickness shall be 0.125 inches.

a. Gel Coat and resin selection: Gel coat and resin shall be selected to withstand the installed environment. Both UV and corrosion resistance shall be considered paramount.
b. Reinforcements shall be either type “A” or “C” glass. The use of “E” glass roving shall be strictly prohibited.

c. Face skin shall be fused to stiles, rails, and stiffeners using two-part 100 percent reactive urethane adhesive, and then cured under pressure until completely bonded.

D. Fiberglass Frames

1. Constructed of 0.1875 inch thick Fiberglass pultrusions:

a. Jamb depths and faces as indicated by drawing details and/or door and frame schedule on drawings.
b. Provide frames with mitered corners, resin welded and ground smooth unless specifically noted otherwise.
c. Reinforcing:
1) Corner Reinforcement: 4”x4”x5-3/8”x1/4” pultruded fiberglass angle.
2) Strike Reinforcement: 1-1/2” x 8” x 3/4” thick polymer material.
3) Closer Reinforcement: 1-1/8”x18”x1/4” polymer bonded to frame.
4) Provide adequate reinforcing for other hardware as required in approved finish hardware schedule.

2. Provide proper type base and jamb anchors for all frames.

a. Provide standard rubber silencers, 3 per strike jamb and 2 per head jamb for pairs.

3. Removable mullion: Provide full depth removable mullion of matching construction for Door #106. Set screws shall be on interior for security.

2.2 ACCESSORIES

A. Provide all required accessories for proper assembly and installation, including but not limited to, stainless steel screws, clips, washers, bolts, anchors, splice plates, spacers, and similar items, whether specifically mentioned herein or not.

PART 3 - EXECUTION

3.1 FABRICATION

A. Fabricate all doors, frames and accessories in strict accordance with this specification and Door Manufacturer’s manufacturing specifications.

3.2 MACHINING AND FITTING

A. All fiberglass doors shall be machined by the manufacturer or authorized manufacturer for cutouts, hinges, locks, closures and all hardware requiring routing and mortising. Doors shall be sized to allow 0.125 inches of clearance at top and each side and 5/8 inch clearance at bottom (unless specified otherwise).

3.3 INSTALLATION OF HARDWARE

A. Contractor shall install hardware according to approved hardware schedule for proper locations.

B. Install with full threaded screw furnished by hardware manufacturer.

C. Drill proper size pilot holes for all screws.

D. Securely anchor hardware in correct position and proper alignment.

E. Adjust hardware and door for proper function and smooth operation, proper latching, without force or excessive clearance.

3.4 FIELD FINISHING

A. Doors and frames are furnished with a polyurethane primer. Contractor shall apply finish paint as recommended by manufacturer that is compatible with the primer coat.

DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Commercial door hardware.

1.2 SUBMITTALS

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

B. Other Action Submittals:

1. Door Hardware Sets: Prepared by or under the supervision of Architectural Hardware Supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams.

a. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.
b. Content: Include the following information:

1) Identification number, location, hand, fire rating and material of each door and frame.
2) Type, style, function, size, quantity, and finish of each door hardware item. Include description and function of each lockset and exit device.

3) Complete designations of every item required for each door or opening including name and manufacturer.
4) Description of each electrified door hardware function, including location, sequence of operation, and interface with other building control systems.

2. Keying Schedule: Prepared by or under the supervision of Architectural Hardware Supplier, detailing Owner's final keying instructions for locks.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by lock manufacturer.

1. Installer's responsibilities include supplying and installing door hardware and providing a qualified Architectural Hardware Consultant available during the course of the Work to consult with Contractor, Engineer, and Owner about door hardware and keying.

B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.

1.4 COORDINATION

A. Templates: Distribute door hardware templates for doors, frames, and other work specified to be factory prepared for installing door hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Three years from date of Substantial Completion, except as follows:

a. Manual Closers: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. General: Provide door hardware for each door to comply with requirements in this Section and door hardware sets indicated in door and frame schedule and door hardware sets indicated in Part 3 "Door Hardware Sets" Article.

1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and products complying with BHMA standard referenced.

B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door Hardware Sets" Article. Products are identified by using door hardware designations, as follows:

1. References to BHMA Standards: Provide products complying with these standards and requirements for description, quality, and function.

2.2 HINGES, GENERAL

A. Template Requirements: Provide only template-produced units.

B. Hinge Base Metal: Unless otherwise indicated, provide the following:

1. Interior Hinges: Steel, with steel pin.

2. Hinges for Fire-Rated Assemblies: Steel, with steel pin.

C. Fasteners: Comply with the following:

1. Machine Screws: For metal doors and frames. Install into drilled and tapped holes.

2. Threaded-to-the-Head Wood Screws: For fire-rated wood doors.

3. Screws: Phillips flat-head; machine screws (drilled and tapped holes) for metal doors. Finish screw heads to match surface of hinges.

2.3 HINGES

A. Butts and Hinges: BHMA A156.1.

B. Template Hinge Dimensions: BHMA A156.7.

2.4 CONTINUOUS HINGES

A. Standard: BHMA A156.26, Grade 1

B. Continuous, Gear-Type, Concealed Leaf (Butt Mount) Hinges: Extruded-aluminum, pinless, geared hinge leaves; joined by continuous extruded-aluminum channel cap; with concealed, self-lubricating thrust bearings.

2.5 LOCKS AND LATCHES, GENERAL

A. Accessibility Requirements: Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.

B. Latches and Locks for Means of Egress Doors: Comply with NFPA 101. Latches shall not require more than 15 lbf to release the latch. Locks shall not require use of a key, tool, or special knowledge for operation.

C. Lock Trim:

1. Levers: Lever trim shall return to within ½" of door.

2. Dummy Trim: Match lever lock trim and escutcheons.

D. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors.

E. Backset: 2-3/4 inches, unless otherwise indicated.

F. Strikes: Manufacturer's standard strike with strike box for each latchbolt or lock bolt, with curved lip extended to protect frame, finished to match door hardware set.

2.6 MECHANICAL LOCKS AND LATCHES

A. Lock Functions: Function descriptions indicated in door hardware sets comply with the following:

1. Mortise Locks: BHMA A156.13.

B. Mortise Locks: Stamped steel case with steel or brass parts; BHMA A156.13, Grade 1, Series 1000, Heavy-duty.

2.7 LOCK CYLINDERS

A. High-Security Lock Cylinders: BHMA A156.30, Grade 1

1. Key Control Level: Category A.

2. Destructive Test Level: Category A.

3. Surreptitious Entry Resistance Level: Category A.

B. Cylinders: Manufacturer's standard tumbler type, constructed from brass or bronze, stainless steel, or nickel silver, and complying with the following:

1. Number of Pins: Six.

2. High-Security Grade: BHMA A156.5, Grade 1A, listed and labeled as complying with pick- and drill-resistant testing requirements in UL 437 (Suffix A).

C. Permanent Cores: Manufacturer's standard; finish face to match lockset; with interchangeable cores.

D. Construction Keying: Comply with the following:

1. Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide 10 construction master keys.

2. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.

a. Furnish permanent cores to Owner for installation.

E. Manufacturer: Same manufacturer as for locks and latches.

2.8 KEYING

A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A. Incorporate decisions made in keying conference into master key system.

1. Existing System: Master key or grand master key locks to Owner's existing system.

B. Keys: Nickel silver; permanently inscribed with a visual key control number and including the notation "DO NOT DUPLICATE."

1. Quantity: In addition to one extra key blank for each lock, provide three cylinder change keys and five master keys.

2.9 CLOSERS

A. Accessibility Requirements: Comply with the following maximum opening-force requirements:

1. Interior, Non-Fire-Rated Hinged Doors: 5 lbf applied perpendicular to door.

2. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.

B. Door Closers for Means of Egress Doors: Comply with NFPA 101. Door closers shall not require more than 30 lbf to set door in motion and not more than 15 lbf to open door to minimum required width.

C. Size of Units: Unless otherwise indicated, comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to

weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

D. Surface Closers: BHMA A156.4, Grade 1. Provide type of arm required for closer to be located on non-public side of door, unless otherwise indicated.

2.10 DOOR GASKETING/SILENCERS

A. Standard: BHMA A156.22.

B. General: Provide continuous weather-strip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated or scheduled. Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

1. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

2. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

3. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

D. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

E. Gasketing Materials: ASTM D 2000 and AAMA 701/702.

F. Silencers for Door Frames: BHMA A156.16, Grade 1; neoprene or rubber; fabricated for drilled-in application to frame. Provide for all frames not receiving weatherstripping or smoke gasketing.

G. Door Sweeps: Gasket material held in place by flat metal housing or flange; surface mounted to face of door with screws.

1. Gasket Material: Neoprene

2.11 THRESHOLDS

A. Standard: BHMA A156.21.

B. Accessibility Requirements: Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch high.

C. Thresholds for Means of Egress Doors: Comply with NFPA 101. Maximum 1/2 inch high.

D. Saddle Thresholds: Fluted top.

2.12 DRIP CAPS

A. Standard: BHMA A156.22

B. Clear anodized extruded aluminum, 2-1/2" projection. Furnish units in length to fit openings.

2.13 FABRICATION

A. Base Metals: Produce door hardware units of base metal, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18. Do not furnish manufacturer's standard materials or forming methods if different from specified standard.

B. Fasteners: Provide screws according to commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.

1. Comply with NFPA 80 for fasteners of door hardware in fire-rated applications.

C. Finishes: BHMA A156.18, as indicated in door hardware sets.

PART 3 - EXECUTION

3.1 INSTALLATION

A. FRP Doors and Frames: Comply with DHI A115 Series. Drill and tap doors and frames for surface-applied door hardware according to ANSI A250.6.

B. Mounting Heights: Mount door hardware units at heights indicated as follows unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel and FRP Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."

C. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 09 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."

E. Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Door Closers: Unless otherwise required by authorities having jurisdiction, adjust sweep period so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the leading edge of the door.

3.2 DOOR HARDWARE SETS

Door Hardware Set No. 01
Doors No. 2A, 3A Exterior Singles; each to have the following:

No.	Item	Description	Finish
1	Hanging Device	Continuous Hinge	Clear
1	Securing Devices	Entrance Function Leverset	US26D
1	Closing Devices	Surface Closer	689
1	Miscellaneous Trim	Threshold	Alum
1	Miscellaneous Trim	Drip Cap	Clear
1	Seals	Weatherstripping	Set Black
1	Seals	Door Bottom	US26D

Door Hardware Set No. 2
Doors No. 106 Exterior Pair with Center Mullion; to have the following:

No.	Item	Description	Finish
2	Hanging Devices	Continuous Hinges	Clear
2	Securing Devices (one per leaf)	Entrance Function Leverset	US26D
2	Closing Devices	Surface Closer	689
2	Miscellaneous Trim	Threshold	Alum
1	Miscellaneous Trim	Removable Center Mullion	Alum
1	Miscellaneous Trim	Drip Cap	Clear
2	Seals	Weatherstripping	Set Black
2	Seals	Door Bottom	US26D

Door Hardware Set No. 3
Door No. 109; to have the following:

No.	Item	Description	Finish
3	Hanging Devices	Butt Hinges	US26D
1	Securing Device	Privacy Leverset	US26D
1	Closing Devices	Surface Closer	689

TOILET ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Work includes

1. Provide complete, in place, the toilet accessories for the project, as shown, noted, or scheduled on the drawings and as specified herein.

1.2 SUBMITTALS

A. Product Data/Samples

1. Submit for Engineer's approval: (minimum 5 copies required)

a. Manufacturer's catalog or data sheets on all specified products together with manufacturer's recommended installation instructions.

1.3 QUALITY ASSURANCE

A. Contractor shall employ only skilled and experienced workmen/workwomen who are fully qualified and familiar with the assembly and recommended installation procedures for specified products.

PART 2 - PRODUCTS

2.1 GRAB BARS

A. 1½" OD, Type 304 Stainless Steel, 18 gauge, smooth satin finish, concealed mounting type. Provide in lengths and configurations indicated on the drawings.

2.2 PAPER HOLDERS

A. Surface mounted single roll type, Type 304 Stainless Steel, polished finish. Provide at each water closet location except those located within toilet compartments specified elsewhere.

2.3 MIRRORS

A. Stainless steel mirror, concealed wall hangers slotted for concealed mounting with theft resistant devices. Provide type 304 stainless steel square corner channel frames with polished finish. Provide mirrors in sizes noted or indicated on the drawings.

2.4 PAPER TOWEL DISPENSER

A. Surface mounted, stainless steel, roll-paper towel dispenser, accepts 9" standard core roll. Full-length stainless steel piano hinge, tumbler lock. Provide one per lavatory or wash fountain. Located as directed by Engineer/Owner.

2.5 SHOWER SEAT

A. Provide water resistant, ivory-colored 1/2” thick phenolic reversable folding shower seat. Frame and mounting brackets are type 304 stainless steel with self-locking mechanism.

2.5 SHOWER CURTAIN / ROD

A. Provide 36” long 1” diameter rod. 20 gage type 304 stainless steel, satin finish. Flanges to be chrome plated plastic, mount on concealed wall brackets.
B. Shower curtain to be 70” W x 72” H opaque, matte white vinyl, 0.008” thick, nickel plated grommets along top, one every 6”. Provide 12 type 304 stainless steel shower curtain hooks.

2.5 MISC. MATERIALS / ACCESSORIES

A. Provide proper type anchoring devices for specific type wall construction or partition type involved for securing all items.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Coordinate as required with other trades to assure proper and adequate provisions in the work of those trades for interface with the work of this section, including proper wood backing in building partitions.

B. Install each item in its proper location, firmly anchored into position, level and plumb, and in accordance with manufacturer's recommendations and proper installation templates.

<u>FIRE EXTINGUISHERS</u>

GENERAL

1.1 SUMMARY

A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

1.2 SUBMITTALS

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

1.3 QUALITY ASSURANCE

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

C. Coordinate type and capacity of fire extinguishers with fire protection cabinets to ensure fit and function.

1.4 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure of hydrostatic test according to NFPA 10.
b. Faulty operation of valves or release levers.

2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each mounting bracket indicated.

1. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B.

B. Multipurpose Dry-Chemical Type 20A: 120B: C, UL-rated 20 pound nominal capacity, with monoammonium phosphate-based dry chemical in manufacturer's standard enameled container.

2.2 MOUNTING BRACKETS

A. Mounting Brackets: Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated red baked-enamel finish.

B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location.

1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
a. Orientation: Vertical.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged fire extinguishers.

B. Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.

1. Mounting Brackets: 46 inches above finished floor to top of fire extinguisher.

C. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

Schedule of Values:

1.1 A Schedule of Values shall be submitted as payment basis for PUMP STATION GENERAL WORK.

1.2 The Contractor shall submit a Schedule of Values, as specified herein, at the Pre-Construction Meeting and shall provide information as requested to substantiate the prices included in the Schedule of Values.

1.3 The Schedule of Values must be approved by the Engineer and District 8, Bureau Electrical Operations, prior to any project payments.

1.4 Complete Schedule of Values

(a) The Schedule of Values shall be typewritten on 8-1/2 inch by 11 inch paper in a format approved by the Engineer.

(b) The Schedule of Values shall be used to determine the value of work completed for payment purposes. After review by the Engineer, the Contractor shall revise and resubmit the Schedule of Values as required.

(c) The Schedule of Values shall have each item further itemized by Specification Division as listed in the Specification index.

(d) For the item Pump Station General Work, each item which has an installed value of over $10,000, a list of the costs for the major products or operations shall be indicated under each item. Round off figures to the nearest ten (10) dollars. The "value" for each item listed shall be the supplied, installed and operational start-up cost incurred to the Contractor for that item (overhead and profit included). No items shall be listed as calendar units (i.e. per month). The sum total of all items in the Schedule shall be equal to the payment item total.

CONTROL BUILDING FURNITURE

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Control Room Desk
2. Control Room Chairs

1.2 SUBMITTALS

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

PART 2 - PRODUCTS

2.1 MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Steel Sheet: ASTM A 569/A 569M, Type B, unless otherwise indicated.

C. Steel Tubing: ASTM A 513, Type B, unless otherwise indicated; thickness indicated or required by structural loads.

D. Steel Pipe: ASTM A 53, Standard Weight (Schedule 40), unless another weight is indicated or required by structural loads.

E. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 304.

2.2 CONTROL ROOM FURNITURE

A. Floor-Mounted Desk:

1. Desk Top: Formed from 0.1406-inch- thick, stainless-steel sheet; with minimum 1½ inch flanged edges.

a. Size: Verify size with owner

2. Pedestal: Provide 2 storage shelves with sides and shelves formed from 0.1265-inch- thick steel sheet.

3. Pencil Drawer:

4. Legs: Formed from 1½ inch-square by 3/16-inch- thick steel tubing welded to desk top and mounting plate for an overall desk height of not less than 30 inches.

5. Mounting Plate: Formed from ¼ inch- thick steel plate punched with 1 hole for floor anchorage; provide 1 mounting plate for each leg.

6. Finish: Baked enamel grey in color.

B. Stacking Chair (four required):

1. Provide powder coated tubular steel frame with seat and back of contoured UV- protected high-density polyethylene plastic, 17" seat height, meets BIFMA standards and provide with manufacturer's 5-year limited warranty.

2.3 FABRICATION

A. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Coordinate dimensions and attachment methods of detention furnishings with those of adjoining construction to produce integrated assemblies with closely fitting joints and with edges and surfaces aligned, unless otherwise indicated.

C. Shear and punch metals cleanly and accurately. Remove burrs.

D. Form edges and corners to be free of sharp edges or rough areas. Fold back and crimp exposed edges of unsupported sheet metal to form a ½ inch- wide hem on the concealed side; ease edges of metal plate to a radius of approximately 1/32 inch.

1. Fabricate detention furnishings with no more than 1/32 inch gap between component materials. Weld edges that cannot be crimped to meet tolerance so as to provide a seamless joint with no places for concealment of contraband.

E. Form metal in maximum lengths to minimize joints. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

F. Weld corners and seams continuously to comply with referenced AWS standard and the following:

1. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

G. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to secure metal fabrications rigidly in place and to support expected loads. Build in straps, plates, and brackets as needed to support and anchor fabricated items to adjoining construction. Reinforce formed-metal units as needed to attach and support other construction.

H. Cut, reinforce, drill, and tap metal fabrications to receive hardware, security fasteners, and similar items.

I. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.

J. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Use exposed security fasteners of type indicated or, if not indicated, flat-head (countersunk) security fasteners. Locate joints where least conspicuous.

K. Attach drawer slides and shelves to furniture with security fasteners.

2.4 FINISHES

A. Steel Finish: Baked-enamel finish with minimum dry film thickness of 1.2 mils.

B. Stainless-Steel Finish: Intermediate Polish Finish, No. 3, unless otherwise indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Coordinate location of furniture with owner.

Method of Measurement: Pump Station General Work in accordance with this provision will be measured for payment on a lump sum basis.

Basis of Payment: This work will be paid for at the contract unit price per LUMP SUM for PUMP STATION GENERAL WORK**.**

PRECAST PUMP STATION BUILDING

PRECAST WALL PANELS

SUMMARY

1. This section includes the performance criteria, materials, design, production, and erection of architectural precast concrete wall panels. The work performed under this Section includes all labor, material, equipment, related services, and supervision required for the manufacture and erection of the architectural precast concrete work shown on the Contract Drawings.

2. This Section includes the following:
   A. High performance architectural precast insulated sandwich wall panels with following finishes:
      a) Stamped Brick finish.
      b) Dye to match existing building
   B. Wall panels

C. Grout packing.
D. Connection and supporting devices.

DEFINITION

1. Design Reference Sample: Sample of approved architectural precast concrete color, finish, form, texture and graphic design preapproved by Engineer/Owner.

COORDINATION

1. Fabricator shall coordinate with electrical contractor to ensure all recessed boxes and conduit are installed at the correct location and elevation.

PERFORMANCE REQUIREMENTS

1. Structural Performance: Provide architectural precast concrete units and connections capable of withstanding the following design loads within limits and under conditions indicated:
2. Loads: As indicated on drawings.
3. Design precast concrete units and connections to maintain clearances at openings, to allow for fabrication and construction tolerances, to accommodate live-load deflection, shrinkage and creep of primary building structure, and other building movements as follows:
4. Maximum Allowable Deflection: 1/360 span.
5. Thermal Movements: Provide for in-plane thermal movements resulting from annual ambient temperature or cyclic day/night changes of 80 °F (26 °C).
6. Member connection design shall consider through thickness thermal gradients as appropriate.
7. Connection design shall consider thermal stresses induced by welding. Connection design shall consider construction tolerances, welding tolerances, and alignment tolerances.
8. Fire Resistance Rating: Select material and minimum thicknesses to provide 2 - hour fire rating at locations shown on drawing.

SUBMITTALS

1. Product Data: For each type of product indicated. Retain quality control records and certificates of compliance for 5 years after completion of structure.
2. Design Mixtures: For each precast concrete mixture. Include results of compressive strength and water-absorption tests.
3. Shop (Erection) Drawing:
   A. Detail fabrication and installation of architectural precast concrete units.
   B. Indicate locations, plan views, elevations, dimensions, shapes, and cross-sections of each unit.
   C. Indicate aesthetic intent including joints, drips, chamfers, rustications or reveals, and extent and location of each surface finish.
   D. Indicate details at building corners.
   E. Indicate separate face and backup mixture locations and thicknesses.
   F. Indicate welded connections by AWS standard symbols and show size, length, and type of each weld.
   G. Indicate locations, tolerances, and details of anchorage devices to be embedded in or attached to structure or other construction.
   H. Indicate locations, extent, and treatment of dry joints if two-stage casting is proposed.

I. Indicate plan views and elevations showing unit location and dimensions, erection sequences, and bracing plan for special conditions.
J. Indicate location of each architectural precast concrete unit by same identification mark placed on unit.
K. Indicate relationship of architectural precast concrete units to adjacent materials.
L. Indicate multiple wythe connection details.
M. Indicate shim sizes and grouting sequence.
N. Coordinate and indicate openings and inserts required by other trades.
O. Clearly indicate loads which are transferred to portions of the structure designed by the Engineer of Record.
P. Design Modifications: If design modifications are proposed to meet performance requirements and field conditions, notify the Engineer and submit design calculations and Shop Drawings. Do not adversely affect the appearance, durability, or strength of units when modifying details or materials and maintain the general design concept.
Q. Comprehensive engineering design signed and sealed by qualified structural engineer responsible for its preparation licensed in the jurisdiction in which the project is located. Show governing panel types, connections, concrete cover and reinforcement types, including special reinforcement such as epoxy coated carbon fiber grid. Indicate location, type, magnitude, and direction of loads imposed on the building structural frame by the architectural precast concrete.
R. Samples: Design reference samples for initial verification of design intent, approximately 12 x 12 x 2 in., representative of finishes, color, and textures of exposed surfaces of architectural precast concrete units.
    1. When back face of precast concrete unit is to be exposed, include Samples illustrating workmanship, color, and texture of the backup concrete as well as facing concrete.
    2. Include 12 x 12 samples of graphic concrete surface finish.

INFORMATIONAL SUBMITTALS

1. Qualification Data: For fabricator agency and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include list of completed projects with project names and addresses, names and addresses of engineers and owners, and other information specified.

2. Welding Certificates: Copies of certificates for welding procedure specifications (WPS) and personnel certification.

3. Material Test Reports for aggregates: From an accredited testing agency, indicating and interpreting test results for compliance with requirements indicated:

4. Material Certificates. For the following items signed by manufacturers:
    A. Cementitious materials.
    B. Reinforcing materials including prestressing tendons.
    C. Admixtures.
    D. Bearing pads.
    E. Structural-steel shapes and hollow structural steel sections.
    F. Insulation.
    G. Other components specified in Contract Documents with applicable standards.

QUALITY ASSURANCE

1. Erector Qualification: Company specializing in preform work of this section with minimum of 5 years documented experience.

2. Fabricator Qualifications: A firm that complies with the following requirements and is experienced in producing architectural precast concrete units similar to those indicated for this Project and with a record of successful in-service performance.

3. Assumes responsibility for engineering architectural precast concrete units to comply with performance requirements. This responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified structural engineer.

4. Structural Engineer Qualifications: A structural engineer who is licensed in the jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of architectural precast concrete that are similar to those indicated for this Project in material, design, and extent.

5. Participates in PCI's Plant Certification program at the time of bidding and is designated a PCI-Certified plant for Group A, Category A1- Architectural Cladding and Loadbearing Units.

6. Has sufficient production capacity to produce required units without delaying the Work.

7. Certification shall be maintained throughout the production of the precast concrete units. Production shall immediately stop if at any time the fabricator's certification is revoked, regardless of the status of completion of contracted work. Production will not be allowed to re-start until the necessary corrections are made and certification has been re-established. In the event certification(s) can not be re-established in a timely manner, causing project delays, the fabricator, at no additional cost, will contract out the remainder of the units to be manufactured at a PCI certified plant.

8. Is registered with and approved by authorities having jurisdiction.

9. Design Standards: Comply with ACI 318 (ACI 318M) and design recommendations of PCI MNL 120, PCI Design Handbook - Precast and Prestressed Concrete, applicable to types of architectural precast concrete units indicated.

10. Quality-Control Standard: For manufacturing procedures and testing requirements, quality-control recommendations, and dimensional tolerances for types of units required, comply with PCI MNL 117, Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products.

11. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code – Steel"; AWS D1.4/D1.4M, "Structural Welding Code - Reinforcing Steel" and AWS D1.6/D1.6M Structural Welding Code-Stainless".

12. Fire Resistance: Where indicated, provide architectural precast concrete units whose fire resistance satisfy the fire resistance ratings of the Contract Documents and meets the prescriptive requirements of the governing code or has been calculated according to [PCI MNL 124, Design for Fire Resistance of Precast Prestressed Concrete) (ACI

216.1/TMS 0216.1, Standard Method for Determining Fire Resistance of Concrete and Masonry Construction Assemblies] and is acceptable to authorities having jurisdiction.

13. Sample Panels: After sample approval and before fabricating architectural precast concrete units, produce a minimum of two sample panels approximately 16 ft^2 in area for review by Engineer. Incorporate full-scale details of architectural features, finishes, textures, and transitions in sample panels.

14. Locate panels where indicated in Contract Document or, if not indicated, as directed by Engineer.

15. Damage part of an exposed-face surface for each finish, color, and texture, and demonstrate adequacy of repair techniques proposed for repair of surface blemishes.

16. After acceptance of repair technique, maintain one sample panel at the fabricator's plant and one at the Project site in an undisturbed condition as a standard for judging the completed Work.

17. Demolish and remove sample panels when directed.

18. Range Sample Panels: After sample panel approval and before fabricating architectural precast concrete units, produce a minimum of three samples, approximately 16 ft^2 in area, representing anticipated range of each color and texture on Project's units. Maintain samples at the fabricator's plant as color and texture acceptability reference.

DELIVERY, STORAGE, AND HANDLING

1. Deliver precast concrete units in such quantities and at such times to ensure compliance with the agreed upon project schedule and setting sequence and also to limit unloading units temporarily on the ground or other rehandling.

2. Support units during shipment on non-staining shock-absorbing material.

3. Store units with adequate dunnage and bracing, and protect units to prevent contact with soil, to prevent staining, and to prevent cracking, distortion, warping, or other physical damage.

4. Place stored units so identification marks are clearly visible, and units can be inspected.

5. Handle and transport units in a manner to avoid excessive stresses which could cause cracking or damage.

6. Lift and support units only at designated points indicated on Shop Drawings.

7. Protect members to prevent staining, chipping, or spalling of concrete.

SEQUENCING

1. Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction without delaying the Work. Provide locations, setting diagrams, templates, instructions, and directions, as required, for installation.

MOLD MATERIALS

1. Molds: Rigid, dimensionally stable, non-absorptive material, warp and buckle free, that will provide continuous and true precast concrete surfaces and reveals within fabrication tolerances indicated; nonreactive with concrete and suitable for producing required finishes.

2. Form-Release Agent: Commercially produced form-release agent that will not bond with, stain, or affect hardening of precast concrete surfaces and will not impair subsequent surface or joint treatments of precast concrete

3. Physical Characteristics of Elastomeric Form Liner – high-use – reusable approximately 100 times.

   A. Hardness – D2240 – Shore A: 70
   B. Tensile Properties PSI – DF12 565.0 S100%
   C. Elongation D412 – Percent: 294.3% elongation
   D. Tear Strength D624 & D3489 die C: 168.9 PLI
   E. Tensile Strength D412: 1569.3 PSI
   F. Abrasion – Taber H22: .0698 WTLOS – Taber Abrasion D3489 MG/1000 cycles: .256% by weight.
   G. Color – Gray

4. Accessories: provide fasteners, sealant, rustication & back-up strips, form release agents as recommended by manufacturer.

REINFORCING MATERIALS

1. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.
2. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.
3. Steel Bar Mats: ASTM A 184/A 184M, fabricated from ASTM A 615/A 615M, Grade 60 (Grade 420) or ASTM A 706/A 706M deformed bars, assembled with clips.
4. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, fabricated from as-drawn steel wire into flat sheets.
5. Deformed Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.
6. Supports: Suspend reinforcement from back of mold or use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 117.

PRESTRESSING TENDONS

1. Prestressing Strand: ASTM A 416/A 416M, Grade 270 (Grade 1860), uncoated, 7-wire, low-relaxation strand.

2. Unbonded Post-Tensioning Strand: ASTM A 416/A 416M, Grade 270 (Grade 1860), 7-wire, low-relaxation strand with corrosion inhibitor coating conforming to ACI 423.7, with polypropylene tendon sheathing. Include anchorage devices.

3. Post-Tensioning Bars: ASTM A 722/A 722 M, uncoated high strength steel bar.

CONCRETE MATERIALS

1. Portland Cement: ASTM C150, Type I or III.
   A. For surfaces exposed to view in finished structure, use white, of same type, brand, and mill source throughout the precast concrete production.

B. Standard gray Portland cement may be used for non-exposed backup concrete.

2. Normal weight Aggregates: Except as modified by PCI MNL 117, ASTM C 33, with coarse aggregates complying with Class 5S. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.
3. Face-Mixture Coarse Aggregates: Selected, hard, and durable; free of material that reacts with cement or causes staining; to match selected finish sample.
   A. Gradation: To match design reference sample.

4. Face-Mixture Fine Aggregates: Selected, natural, or manufactured sand of a material compatible with coarse aggregate to match selected Sample finish.

5. Backup Concrete Aggregates: ASTM C 33 or C 330.

6. Coloring Admixture: ASTM C 979, synthetic or natural mineral-oxide pigments or colored water-reducing admixtures, temperature stable, and nonfading.

7. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 117.

8. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.

9. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride, or more than 0.15 percent chloride ions or other salts by weight of admixture.
   A. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
   B. Retarding Admixture: ASTM C 494/C 494M, Type B.
   C. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
   D. Water-Reducing and Accelerating Admixture: ASTM C 494/C 494M, Type E.
   E. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
   F. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
   G. Plasticizing Admixture for Flowable Concrete: ASTM C 1017/C 1017M.
   H. Corrosion Inhibiting Admixture: ASTM C 1582/C 1582M.

STEEL CONNECTION MATERIALS

1. Carbon-Steel Shapes and Plates: ASTM A 36/A 36M.

2. Carbon-Steel Headed Studs: ASTM A 108, Grades 1010 through 1020, cold finished, AWS D1.1/ D1.1 M, Type A or B, with arc shields and with minimum mechanical properties of PCI MNL 117, Table 3.2.3.

3. Carbon-Steel Plate: ASTM A 283/A 283M, Grade C.

4. Malleable Iron Castings: ASTM A 47/A 47M, Grade 32510 or 35028.

5. Carbon-Steel Castings: ASTM A 27/A 27M, Grade 60-30 (Grade 415-205).

6. High-Strength, Low-Alloy Structural Steel: ASTM A 572/A 572M.

7. Carbon-Steel Structural Tubing: ASTM A 500/A 500M, Grade B or C.

8. Wrought Carbon-Steel Bars: ASTM A 675/A 675M, Grade 65 (Grade 450).

9. Deformed-Steel Wire or Bar Anchors: ASTM A 496/A 496 M or ASTM A 706/A 706M.

10. Carbon-Steel Bolts and Studs: ASTM A 307, Grade A or C (ASTM F 568M, Property Class 4.6) carbon-steel, hex-head bolts and studs; carbon-steel nuts (ASTM A 563/A 563M, Grade A); and flat, unhardened steel washers, ASTM F 844.

11. High-Strength Bolts and Nuts: ASTM A 193/A 198M, Grade B5 or B7, ASTM A 325/A 325M, or ASTM A 490/A 490M, Type 1, heavy hex steel structural bolts, heavy hex carbon-steel nuts, (ASTM A 563/A 563M) and hardened carbon-steel washers (ASTM F 436/F 436M).

12. Shop-Primed Finish: Prepare surfaces of nongalvanized steel items, except those surfaces to be embedded in concrete, according to requirements in SSPC-SP 3 and shop-apply lead- and chromate-free, rust-inhibitive primer, complying with performance requirements in MPI 79 SSPC-Paint 25 according to SSPC-PA 1.

13. Zinc-Coated Finish: For steel items in exterior walls and items indicated for galvanizing, apply zinc coating by hot-dip process according to ASTM A 123/A 123M, after fabrication, ASTM A 153/A 153M, or ASTM F 2329 as applicable.

14. For steel shapes, plates, and tubing to be galvanized, limit silicon content of steel to less than 0.03 percent or to between 0.15 and 0.25 percent or limit sum of silicon content and 2.5 times phosphorous content to 0.09 percent.

15. Galvanizing Repair Paint: Zinc paint with dry film containing not less than 94 percent zinc dust by weight, and complying with DOD-P-21035B or SSPC-Paint 20. Comply with manufacturer's requirements for surface preparation.

BEARING PADS AND OTHER ACCESSORIES

1. Provide one of the following bearing pads for architectural precast concrete units as recommended by precast concrete fabricator for application:

2. Elastomeric Pads: AASHTO M 251, plain, vulcanized, 100 percent polychloroprene (neoprene) elastomer, molded to size or cut from a molded sheet, 50 to 70 Shore A durometer according to ASTM D 2240, minimum tensile strength 2250 psi (15.5 MPa) per ASTM D 412.

3. Random-Oriented, Fiber-Reinforced Elastomeric Pads: Preformed, randomly oriented synthetic fibers set in elastomer. Surface hardness of 70 to 90 Shore A durometer according to ASTM D 2240. Capable of supporting a compressive stress of 3000 psi (20.7 MPa) with no cracking, splitting, or delaminating in the internal portions of the pad. Test one specimen for each 200 pads used in Project.

4. Cotton-Duck-Fabric-Reinforced Elastomeric Pads: Preformed, horizontally layered cotton-duck fabric bonded to an elastomer. Surface hardness of 80 to 100 Shore A

durometer according to ASTM D 2240. Conforming to Division II, Section 18.10.2 of AASHTO LRFD Bridge Design Specifications, or Military Specification, MIL-C-882E.

5. Frictionless Pads: Tetrafluoroethylene (Teflon), glass-fiber reinforced, bonded to stainless or mild-steel plates, or random-oriented, fiber-reinforced elastomeric pads, of type required for in-service stress.

6. High-Density Plastic: Multimonomer, nonleaching, plastic strip capable of supporting loads with no visible overall expansion.

7. Erection Accessories: Provide clips, hangers, high-density plastic or steel shims, and other accessories required to install architectural precast concrete units.

8. Welding Electrodes: Comply with AWS standards for steel type and/or alloy being welded.

GROUT MATERIALS

1. Sand-Cement Grout: Portland cement, ASTM C 150, Type I, and clean, natural sand, ASTM C 144 or ASTM C 404. Mix at ratio of 1 part cement to 21/2 to 3 parts sand, by volume, with minimum water required for placement and hydration. Water-soluble chloride ion content of grout with less than 0.06 percent chloride ion by weight of cement when tested in accordance with ASTM C 1218/C 1218M.

2. Nonmetallic, Nonshrink Grout: Premixed, prepackaged non-ferrous aggregate, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, plasticizing and water-reducing admixtures, complying with ASTM C 1107, Grade A for drypack and Grades B and C for flowable grout and of consistency suitable for application within a 30-minute working time. Water-soluble chloride ion content of grout with less than 0.06 percent chloride ion by weight of cement when tested in accordance with ASTM C 1218/C 1218M.

3. Epoxy-Resin Grout: Two-component, mineral-filled epoxy-resin: ASTM C 881/C 881M of type, grade, and class to suit requirements.

INSULATED PANEL ACCESSORIES

1. Extruded-Polystyrene Board Insulation: ASTM C 578, R-value – 15.

2. Wythe Connectors: Non-conductive – no thermal bridging allowed.
   A. Provide holes in insulation for connector placement at least 4 in. (100 mm) and no more than 12 in. (0.30 m) from edges of panel or openings.

CONCRETE MIXTURES

1. Prepare design mixtures to match sample or for each type of precast concrete required

2. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast concrete plant personnel at architectural precast concrete fabricator's option.

3. Limit water-soluble chloride ions to the maximum percentage by weight of cement permitted by ACI 318 (ACI 318M) or PCI MNL 117 when tested in accordance with ASTM C 1218/C 1218M.

4. Normal-weight Concrete Face and Backup Mixtures: Proportion mixtures by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal weight concrete with the following properties:
   A. Compressive Strength (28 Days): 5000 psi minimum.
   B. Release Strength: As required by design.
   C. Maximum Water-Cementitious Materials Ratio: 0.40.
5. Water Absorption: 6 percent by weight or 14 percent by volume, tested according to ASTM C 642, except for boiling requirement.

6. Lightweight Concrete Backup Mixtures: Proportion mixtures by either laboratory trial batch or field test data methods according to ACI 211.2, with materials to be used on Project, to provide lightweight concrete with the following properties:
   A. Compressive Strength (28 Days): 5000 psi minimum.
   B. Release Strength: As required by design.
   C. Unit Weight: Calculated equilibrium unit weight of 115 lb/ft^3, where variations exceed plus or minus 5 lb/ft^3 adjust to plus or minus 3 lb/ft^3, according to ASTM C 567.
7. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 117.

8. When included in design mixtures, add other admixtures to concrete according to manufacturer's written instructions.

MOLD FABRICATION

1. Molds: Accurately construct molds, mortar tight, of sufficient strength to withstand pressures due to concrete placement and vibration operations and temperature changes, and for prestressing and detensioning operations. Coat contact surfaces of molds with release agent before reinforcement is placed. Avoid contamination of reinforcement and prestressing tendons by release agent.

2. Maintain molds to provide completed architectural precast concrete units of shapes, lines, and dimensions indicated in Contract Documents, within fabrication tolerances specified.
   A. Form joints are not permitted on faces exposed to view in the finished work.
   B. Edge and Corner Treatment: Uniformly chamfered.

FABRICATION

1. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware and secure in place during precasting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.

2. Weld headed studs and deformed bar anchors used for anchorage according to AWS D1.1/D1.1M and AWS C5.4, "Recommended Practices for Stud Welding."

3. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing architectural precast concrete units to supporting and adjacent construction.

4. Cast in reglets, slots, holes, and other accessories in architectural precast concrete units as indicated on Contract Drawings.

5. Cast in openings larger than 10 in. in any dimension. Do not drill or cut openings or prestressing strand.

6. Reinforcement: Comply with recommendations in PCI MNL 117 for fabrication, placing, and supporting reinforcement.
    A. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond with concrete. When damage to epoxy-coated reinforcing exceeds limits specified in ASTM A 775/A 775M, repair with patching material compatible with coating material and epoxy coat bar ends after cutting.
    B. Accurately position, support, and secure reinforcement against displacement during concrete- placement and consolidation operations. Completely conceal plastic tipped or corrosion resistant metal or plastic chair support devices to prevent exposure on finished surfaces.
    C. Place reinforcing steel and prestressing tendon to maintain at least 3/4 in. (19 mm) minimum concrete cover. Increase cover requirements for reinforcing steel to 11/2 in. (38 mm) when units are exposed to corrosive environment or severe exposure conditions. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.
    D. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh spacing and wire tie laps, where required by design. Offset laps of adjoining widths to prevent continuous laps in either direction.
7. Reinforce architectural precast concrete units to resist handling, transportation and erection stresses, and specified in-place loads, whichever governs.
8. Prestress tendons for architectural precast concrete units by pretensioning or post-tensioning methods. Comply with PCI MNL 117.
    A. Delay detensioning or post-tensioning of precast, prestressed architectural precast concrete units until concrete has reached its indicated minimum design release compressive strength as established by test cylinders cured under the same conditions as concrete unit.
    B. Detension pretensioned tendons either by gradually releasing tensioning jacks or by heat-cutting tendons, using a sequence and pattern to prevent shock or unbalanced loading.
    C. If concrete has been heat cured, detension while concrete is still warm and moist to avoid dimensional changes that may cause cracking or undesirable stresses.
    D. Protect strand ends and anchorages with bituminous, zinc-rich, or epoxy paint to avoid corrosion and possible rust spots.

9. Comply with requirements in PCI MNL 117 and requirements in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.

10. Place face mixture to a minimum thickness after consolidation of the greater of 1 in. (25 mm) or 1.5 times the nominal maximum aggregate size, but not less than the minimum reinforcing cover as indicated on Contract Drawings.

A. Use a single design mixture for those units in which more than one major face (edge) is exposed.
B. Where only one face of unit is exposed, at the fabricator's option, either of the following mixture design/casting techniques may be used:
    1. A single design mixture throughout the entire thickness of panel.
    2. Separate mixtures for face and backup concrete; using cement and aggregates for each type as appropriate, for consecutive placement in the mold. Use cement and aggregate specified for face mixture. Use cement and aggregate for backup mixture complying with specified criteria or as selected by the fabricator.

11. Place concrete in a continuous operation to prevent cold joints or planes of weakness from forming in precast concrete units.

    A. Place backup concrete to ensure bond with face-mixture concrete.

12. Thoroughly consolidate placed concrete by internal and/or external vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air voids on surfaces. Use equipment and procedures complying with PCI MNL 117.

    A. Place self-consolidating concrete without vibration in accordance with PCI TR-6 "Interim Guidelines for the Use of Self-Consolidating Concrete." If face and backup concrete is used, ensure adequate bond between concrete mixtures.

13. Comply with PCI MNL 117 procedures for hot- and cold-weather concrete placement.

14. Identify pickup points of architectural precast concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each architectural precast concrete unit on a surface that will not show in finished structure.

15. Cure concrete, according to requirements in PCI MNL 117, by moisture retention without heat or by accelerated heat curing using low-pressure live steam or radiant heat and moisture. Cure units until the compressive strength is high enough to ensure that stripping does not have an effect on the performance or appearance of final product.

16. Repair damaged architectural precast concrete units to meet acceptability requirements in PCI MNL 117 and Engineer's approval.

INSULATED PANEL CASTING

1. Cast, screed and consolidate bottom concrete wythe supported by mold.

2. Place insulation boards, abutting edges and ends of adjacent boards. Insert wythe connectors through insulation holes, and consolidate concrete around connectors according to connector manufacturer's written instructions.

3. Ensure bottom wythe or insulation layer are not disturbed after bottom wythe reaches initial set.

4. Cast and screed top wythe to meet required finish.

5. Maintain temperature below 150 deg. F in bottom concrete wythe.

FABRICATION TOLERANCES

1. Fabricate architectural precast concrete units of shapes, lines and dimensions indicated, so each finished unit complies with PCI MNL 117 product tolerances as well as position tolerances for cast-in items.

2. Fabricate architectural precast concrete units of shapes, lines and dimensions indicated, so each finished unit complies with the following product tolerances.

3. Overall Height and Width of Units, Measured at the Face Exposed to View: As follows:
   A. 10 ft or under, Plus or Minus 1/8 in.
   B. 10 to 20 ft, Plus 1/8 in., Minus 3/16 in.
   C. 20 to 40 ft, Plus or Minus 1/4 in.
   D. Each additional 10 ft, add Plus or Minus 1/16 in.

4. Overall Height and Width of Units, Measured at the Face Not Exposed to View: As follows:
   A. 10 ft or under, Plus or Minus 1/4 in.
   B. 10 to 20 ft, Plus 1/4 in., Minus 3/8 in.
   C. 20 to 40 ft, Plus or Minus 3/8 in.
   D. Each additional 10 ft, add Plus or Minus 1/8 in.

5. Total Thickness or Flange Thickness: Plus 1/4 in, Minus 1/8 in.

6. Rib Width: Plus or Minus 1/8 in.

7. Rib to Edge of Flange: Plus or Minus 1/8 in.

8. Distance between Ribs: Plus or Minus 1/8 in.

9. Variation from Square or Designated Skew (Difference in Length of the Two Diagonal Measurements): Plus or Minus 1/8 in. per 72 in or 1/2 in total, whichever is greater.

10. Length and Width of Blockouts and Openings within One Unit: Plus or Minus 1/4 in.

11. Location and Dimensions of Blockouts Hidden from View and Used for HVAC and Utility Penetrations: Plus or Minus 3/4 in.

12. Dimensions of Haunches: Plus or Minus 1/4 in.

13. Haunch Bearing Surface Deviation from Specified Plane: Plus or Minus 1/8 in.

14. Difference in Relative Position of Adjacent Haunch Bearing Surfaces from Specified Relative Position: Plus or Minus 1/4 in.

15. Bowing: Plus or Minus L/360, maximum 1 in.

16. Local Smoothness: 1/4 in. per 10 ft.

17. Warping: 1/16 in. per 12 in. of distance from the nearest adjacent corner.

18. Tipping and Flushness of Plates: Plus or Minus 1/4 in.

19. Dimensions of Architectural Features and Rustications: Plus or Minus 1/8 in.

20. Position Tolerances: For cast-in items measured from datum line location, as indicated on Shop Drawings.

    A. Weld Plates: Plus or Minus 1 in. Do not place embedded plates where continuous steel members are shown as field welded below the surface of the concrete. Allow for tolerances specified in AWS D1.1. for welding.
    B. Inserts: Plus or Minus 1/2 in.
    C. Handling Devices: Plus or Minus 3 in.
    D. Reinforcing Steel and Welded Wire Reinforcement: Plus or Minus 1/4 in. where position has structural implications or affects concrete cover; otherwise, Plus or Minus 1/2 in.
    E. Reinforcing Steel Extending out of Member: Plus or Minus 1/2 in. of plan dimensions.
    F. Tendons: Plus or Minus 1/4 in., perpendicular to panel; Plus or Minus 1 in., parallel to panel.
    G. Location of Rustication Joints: Plus or Minus 1/8 in.
    H. Location of Opening within Panel: Plus or Minus 1/4 in.
    I. Location of Flashing Reglets: Plus or Minus 1/4 in.
    J. Location of Flashing Reglets at Edge of Panel: Plus or Minus 1/8 in.
    K. Reglets for Glazing Gaskets: Plus or Minus 1/8 in.
    L. Electrical Outlets, Hose Bibs: Plus or Minus 1/2 in.
    M. Location of Bearing Surface from End of Member: Plus or Minus 1/4 in.
    N. Allowable Rotation of Plate, Channel Inserts, Electrical Boxes: 2-degree rotation or 1/4 in. maximum measured at perimeter of insert.
    O. Position of Sleeve: Plus or Minus 1/2 in.
    P. Location of Window Washer Track or Buttons: Plus or Minus 1/8 in.
    Q. See the drawings for additional restrictions regarding tolerances.

FINISHES

1. Exposed panel faces shall be free of joint marks, grain, and other obvious defects. Corners, including false joints shall be uniform and straight. Finish exposed-face surfaces of architectural precast concrete units to match approved design reference sample, sample panels, mockups, and as follows:
    - Exterior Face: Stamped Brick Finish to match existing pump station building
        - Dye Brick to match color of existing pump station building
    - Interior Face: Smooth Finish
        - Paint White

SOURCE QUALITY CONTROL

1. Quality-Control Testing: Test and inspect precast concrete according to PCI MNL 117 requirements. If using self-consolidating concrete also test and inspect according to PCI TR-6 "Interim Guidelines for the Use of Self-Consolidating Concrete" and ASTM C 1611/C 1611M, ASTM C 1712, ASTM C 1610/1610M, and ASTM C 1621/C 1621M.

2. In addition to PCI Certification, Owner will employ an accredited independent testing agency to evaluate architectural precast concrete fabricator's quality-control and testing methods.

3. Allow Owner's testing agency access to material storage areas, concrete production equipment, and concrete placement and curing facilities. Cooperate with Owner's testing agency and provide samples of materials and concrete mixtures as may be requested for additional testing and evaluation.

4. Strength of precast concrete units will be considered deficient if units fail to comply with ACI 318 (ACI 318M) concrete strength requirements.

5. Testing: If there is evidence that strength of precast concrete units may be deficient or may not comply with ACI 318 (ACI 318M) requirements, fabricator will employ an independent testing agency to obtain, prepare, and test cores drilled from hardened concrete to determine compressive strength according to ASTM C 42/C 42M and ACI 318/ACI 318M.
    A. A minimum of three representative cores will be taken from units of suspect strength, from locations directed by Engineer.
    B. Cores will be tested in an air-dry condition.
    C. Strength of concrete for each series of three cores will be considered satisfactory if the average compressive strength is equal to at least 85 percent of the 28-day design compressive strength and no single core is less than 75 percent of the 28-day design compressive strength.
    D. Test results will be reported in writing on the same day that tests are performed, with copies to Engineer, Contractor, and precast concrete fabricator. Test reports will include the following:
        1. Project identification name and number.
        2. Date when tests were performed.
        3. Name of precast concrete fabricator.
        4. Name of concrete testing agency.
        5. Identification letter, name, and type of precast concrete unit(s) represented by core tests; design compressive strength; type of break; compressive strength at breaks, corrected for length-diameter ratio; and direction of applied load to core in relation to horizontal plane of concrete as placed.
6. Patching: If core test results are satisfactory and precast concrete units comply with requirements, clean and dampen core holes and solidly fill with precast concrete mixture that has no coarse aggregate, and finish to match adjacent precast concrete surfaces.

7. Acceptability: Architectural precast concrete units that do not comply with acceptability requirements in PCI MNL 117, including concrete strength, manufacturing tolerances, and color and texture range are unacceptable. Chipped, spalled, or cracked units may be repaired, if repaired units match the visual mock-up. The Engineer reserves the right to reject any unit if it does not match the accepted sample panel or visual mock-up. Replace unacceptable units with precast concrete units that comply with requirements.

PREPARATION

1. Prepare support equipment for erection procedure, temporary bracing, and induced loads during erection.

2. Furnish anchorage devices for precast concrete units to be embedded in or attached to the building structural frame or foundation before start of such Work. Provide locations, setting diagrams, templates and instructions for the proper installation of each anchorage device.

EXAMINATION

1. Examine supporting structural frame or foundation and conditions for compliance with requirements for installation tolerances, bearing surface tolerances, and other conditions affecting precast concrete performance.

2. Proceed with precast concrete installation only after unsatisfactory conditions have been corrected.

3. Contractor shall notify precast concrete erector that supporting cast-in-place concrete foundation and building structural framing has attained minimum allowable design compressive strength or supporting steel or other structure is structurally ready to receive loads from precast concrete units prior to proceeding with installation.

ERECTION

1. Install loose clips, hangers, bearing pads, and other accessories required for connecting architectural precast concrete units to supporting members and backup materials.

2. Structural steel fabricator to supply and install miscellaneous steel preweld connection hardware in the shop.

3. Erect architectural precast concrete level, plumb, and square within the specified allowable erection tolerances. Provide temporary supports and bracing as required to maintain position, stability, and alignment of units until permanent connections are completed.
   A. Install temporary steel or plastic spacing shims as precast concrete units are being erected. Surface weld steel shims to each other to prevent shims from separating.
   B. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
   C. Remove projecting lifting devices and use sand-cement grout to fill voids within recessed
   D. Lifting devices flush with surface of adjacent precast concrete surfaces when recess is exposed.
   E. Unless otherwise indicated, provide for uniform joint widths of 3/4 in.

4. Connect architectural precast concrete units in position by bolting, welding, grouting, or as otherwise indicated on Shop (Erection) Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and/or grouting are completed.
   A. Disruption of roof flashing continuity by connections is not permitted; concealment within roof insulation is acceptable.

5. Welding: Comply with applicable AWS D1.1/D1.1M, AWS D1.4/D1.4M and D1.6/D1.6M requirements for welding, welding electrodes, appearance of welds, quality of welds, and methods used in correcting welding work.

A. Protect architectural precast concrete units and bearing pads from damage during field welding or cutting operations and provide noncombustible shields as required.
B. Welds not specified shall be continuous fillet welds, using not less than the minimum fillet as specified by AWS D 1.1/D 1.1M, D 1.4/D 1.4M or D1.6/D1.6M.
C. Clean weld- affected metal surfaces with chipping hammer followed by brushing or power tool cleaning and then reprime damaged painted surfaces in accordance with paint manufacturer's recommendations.
D. For galvanized metal, clean weld-affected metal surfaces with chipping hammer followed by brushing or power tooling cleaning and then apply a minimum 0.004-in.-thick (4 mil) coat of galvanized repair paint to galvanized surfaces in conformance with ASTM A 780/A 780M.
E. Visually inspect all welds critical to precast concrete connections. Visually check all welds for completion and remove, reweld or repair all defective welds.

6. At bolted connections, use upset threads, thread locking compound or other approved means to prevent loosening of nuts after final adjustment.
   A. Where slotted connections are used, verify bolt position and tightness at installation. For sliding connections, properly secure bolt but allow bolt to move within connection slot.
   B. For slip critical connections, one of the following methods shall be used to assure proper bolt pretension:
      1. Compressible Washer Direct Tension Indicators – meeting ASTM F 959
      2. Twist-off Tension Control Bolt – meeting ASTM F 1852.
   C. For slip critical connections, the method to be used and the inspection procedure to be used shall be approved by the Engineer and coordinated with the inspection agency.

7. Grouting or Dry-Packing Connections and Joints: Indicate joints to be grouted and any critical grouting sequences on Shop (Erection) Drawings. Grout connections where required or indicated on Shop (Erection) Drawings. Retain flowable grout in place until it gains sufficient strength to support itself. Alternatively pack spaces with stiff dry pack grout material, tamping until voids are completely filled. Place grout and finish smooth, level, and plumb with adjacent concrete surfaces. Promptly remove grout material from exposed surfaces before it affects finishes or hardens. Keep grouted joints damp for at least 24 hours after initial set.

ERECTION TOLERANCES

1. Erect architectural precast concrete units level, plumb, square, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 117, Appendix I.

2. Erect architectural precast concrete units level, plumb, square, and in alignment without exceeding the following noncumulative erection tolerances.
   A. Plan Location from Building Grid Datum: Plus or Minus 1/2 in.
   B. Plan Location from Centerline of Steel Support: Plus or Minus 1/2 in.
   C. Top Elevation from Nominal Top Elevation:
      1. Exposed Individual Panel: Plus or Minus 1/4 in.
      2. Non-Exposed Individual Panel: Plus or Minus 1/2 in.
   D. Support Elevation from Nominal Support Elevation:
      1. Maximum Low: 1/2 in.
      2. Maximum High: 1/4 in.

E. Maximum Plumb Variation over the Lesser of Height of Structure or 100 ft: 1 in.
F. Plumb in Any 10 ft of Element Height: 1/4 in.
G. Maximum Jog in Alignment of Matching Edges:
    1. Exposed Panel Relative to Adjacent Panel: 1/4 in.
    2. Non-Exposed Panel Relative to Adjacent Panel: 1/2 in.
H. Joint Width (Governs over Joint Taper): Plus or Minus 1/4 in.
    1. Maximum Joint Taper: 3/8 in.
    2. Joint Taper over 10 ft: 1/4 in.
    3. Maximum Jog in Alignment of Matching Faces: 1/4 in.
    4. Differential Bowing or Camber, as Erected, between Adjacent Members of Same Design: 1/4 in.
    5. Opening Height between Spandrels: Plus or Minus 1/4 in.

REPAIRS

1. Repairs will be permitted provided structural adequacy of units and appearance are not impaired.

2. Repair damaged units to meet acceptability requirements of PCI MNL 117.

3. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 20 ft.

4. Prepare and repair damaged galvanized coatings with galvanizing repair paint according to ASTM A 780/A 780M.

5. Wire brush, clean, and paint damaged prime-painted components with same type of shop primer.

6. Remove and replace damaged architectural precast concrete units when repairs do not comply with specified requirements.

CLEANING

1. Clean all surfaces of precast concrete to be exposed to view, as necessary, prior to shipping.

2. Clean mortar, plaster, fireproofing, weld slag, and any other deleterious material from concrete surfaces and adjacent materials immediately.

3. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, dirt, stains and other markings.
    A. Perform cleaning procedures, if necessary, according to precast concrete fabricator's recommendations. Protect adjacent work from staining or damage due to cleaning operations.
    B. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

PRECAST CONCRETE HOLLOW CORE PLANKS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Roof planks.

2. Connection plates brackets and hangers.

3. Grouting plank joint keys.

1.2 DESIGN REQUIREMENTS

A. Design components to withstand dead loads and live loads in restrained condition:

1. Roof Assembly:
   a. 20 psf dead load (Not including self-weight)
   b. 25 psf live load.

B. Maximum Allowable Deflection:

1. Roof Planks: 1/480 of span (live load); 1/360 of span (total load).

1.3 SUBMITTALS

A. Shop Drawings: Indicate plank layout, unit identification marks, connection details, edge conditions, bearing requirements, support conditions, dimensions, openings, openings intended to be field cut, and relationship to adjacent materials.

B. Product Data: Indicate standard component configuration, design loads, deflections, and cambers, fire ratings.

C. Design Data: Indicate calculations for loadings and stresses of planks, prestressing; signed and sealed by licensed Structural engineer.

D. Fabricator's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention.

1.4 QUALITY ASSURANCE

A. Design planks in accordance with requirements of:

1. PCI MNL-120 - Design Handbook.

2. PCI MNL-126 - Manual for the Design of Hollow Core Slabs.

3. PCI MNL-124 - Design for Fire Resistance of Precast Prestressed Concrete.

4. ACI 318.

5. ACI 301.

B. Design connections in accordance with PCI MNL-123 - Manual on Design of Connections for Precast Prestressed Concrete.

C. Produce planks in accordance with requirements of PCI MNL-116. Maintain plant records and quality control program during production of precast planks. Make records available upon request.

D. Apply label from agency approved by authority having jurisdiction to identify each foam plastic insulation board.

1.5 QUALIFICATIONS

A. Fabricator: Company specializing in performing Work of this section with minimum three years documented experience, and that assumes responsibility for engineering precast structural concrete units to comply with performance requirements. Responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.

1. Participates in PCI's Plant Certification program at time of bidding and is designated a PCI-certified plant as follows:

a. Group C, Category C2 - Prestressed Hollowcore and Repetitively Produced Products.

B. Erector: Company specializing in erecting Work of this section with three years documented experience and approved by fabricator.

C. Design planks under direct supervision of a Structural Engineer experienced in design of this Work and licensed in the state where this project is located.

D. Welder: Qualified within previous 12 months for types of welds indicated, in accordance with AWS D1.1 and AWS D1.4.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Lifting or Handling Devices: Capable of supporting member in positions anticipated during manufacture, storage, transportation, and erection.

B. Mark each member with date of production and final position in structure.

1.7 COORDINATION

A. Coordinate roof opening locations, prior to installation.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Concrete Materials: ACI 301

B. Tensioning Steel Tendons: ASTM A416/A416M Grade 270, of diameter appropriate to member design.

C. Deformed Reinforcement: ASTM A615 Grade 60, steel bars.

D. Non-Shrink Grout: Non-metallic, minimum compressive strength of 8000 psi at 28 days.

E. Cement Grout: Minimum compressive strength of 4000 psi at 28 days.

1. Shall be a mixture of not less than one part Portland Concrete to three parts fine sand, and the consistency shall be such that joints can be completely filled but without seepage over adjacent surfaces.

F. Bearing Strips

1. Plastic: multi-monomer plastic strips shall be non-leaching and support construction loads with no visible overall expansion.

2.2 ACCESSORIES

A. Connecting and Supporting Devices: Plates, angles, and inserts: ASTM A36 carbon steel.

B. Core Hole End Plugs: Cardboard insert with stiff concrete fill, foamed-in-place insulation, or glass fiber insulation.

C. Hanger Tabs: Galvanized steel, designed to fit into grouted key joints, capable of supporting 500 lb dead load, predrilled to receive hanger.

D. Anchorage Devices for Mechanical and Electrical Equipment Hangers as indicated in Drawings.

E. Sill Seal: Glass fiber strips.

2.3 FABRICATION

A. Planks: Plant cast, prestressed, hollow core; fabricated in accordance with PCI MNL-126 and ACI 318.

B. Field verify dimensions, prior to fabrication.

C. Weld reinforcing in accordance with AWS D1.4.

D. Cut exposed ends flush.

E. Plant Finish: PCI MNL-116.

1. Roof Members: Standard Grade.

F. Connecting and Supporting Steel Devices: Do not paint surfaces in contact with concrete or surfaces requiring field welding.

2.4 FABRICATION TOLERANCES

A. Tolerances: Conform to PCI MNL-126.

2.5 SOURCE QUALITY CONTROL AND TESTS

A. Test and analyze stressing tendons in accordance with ASTM A416.

B. Test and analyze concrete in accordance with PCI MNL-116 and ACI 318.

C. When fabricator is approved by authority having jurisdiction, submit certificate of compliance indicating Work performed at fabricator's facility conforms to Contract Documents.

1. Specified shop tests are not required for Work performed by approved fabricator.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify site conditions are ready to receive Work and field measurements are taken as indicated on Drawings and Shop Drawings.

B. Verify supporting structure is ready to receive work.

3.2 PREPARATION

A. Prepare support devices for erection procedure and temporary bracing.

3.3 ERECTION

A. Erect members without damage to structural capacity, shape, or finish. Replace or repair damaged members.

B. Align and maintain uniform horizontal and end joints, as erection progresses.

C. Maintain temporary bracing in place until final connections are made. Protect members from staining.

D. Install sill seal at bearing ends of planks as indicated on Shop Drawings.

E. Adjust differential camber between precast members to tolerance before final attachment and grouting.

F. Adjust differential elevation between precast members to tolerance before final attachment.

G. Secure units in place. Perform welding in accordance with AWS D1.1.

H. Tape seal underside or install sealant backer rod in plank joints to prevent grout leakage.

I. Grout longitudinal keys as indicated on Drawings.

J. Make plank-to-plank joints smooth using grout, troweled smooth. Transition differential elevation of adjoining planks with grout to maximum slope of 1 in 12.

3.4 ERECTION TOLERANCES

A. Erect members level and plumb within allowable tolerances. Conform to PCI MNL-126 and PCI MNL-120 - Design Handbook.

B. Exposed Joint Dimension: 3/4 inch plus or minus 1/4 inch for members 0 to 40 feet in length, plus or minus 3/4 inch for members 41 to 61 feet in length, and plus or minus 1 inch for 61 feet plus members.

Method of Measurement: Precast Pump Station Building in accordance with this provision will be measured for payment on a lump sum basis.

Basis of Payment: This work will be paid for at the contract unit price per LUMP SUM for PRECAST PUMP STATION BUILDING.

MASONRY WALL CONSTRUCTION

Description: This work shall consist of constructing the interior non-load bearing masonry brick walls at the new 25th Street Pump Station Control Building.

RESPONSIBILITY OF THE CONTRACTOR

The Contractor shall take precautions to prevent damage to the existing structure remaining in place and all electrical equipment, while performing the masonry wall construction. The Contractor shall be responsible for any damage or destruction of the existing facility resulting from neglect. Whenever damage occurs, the Contractor will restore the damage to a condition equal to that existing before any such damage or destruction was done.

MASONRY MATERIALS

A. Concrete Masonry Units
   1. Conform to ASTM C90, Grade N, Type I,
      a. Normal Weight (Density of unit = 135 pcf),
      b. Minimum block compressive strength = 2400 psi
      c. Specified design strength of masonry, fm' = 1500.

d. Color and Finish: As selected by owner.

e. Masonry units shall be fabricated with integral water repellant additive.

1. Liquid water-repellant mortar admixture intended for use with concrete masonry units, containing integral water repellent by same manufacturer.

B. Mortar Material

1. ASTM C270 Type "S" mortar.

C. Grout to fill cores

1. ASTM C476, Coarse grout (3/8" maximum aggregate) with a minimum compressive strength of 3,000 psi in 28 days.

D. Reinforcing Bars

1. ASTM A615, Grade 60.

PROJECT CONDITIONS

A. Cold-Weather Requirements

1. Do not use frozen materials or materials mixed or coated with ice or frost. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

B. Hot-Weather Requirements

1. Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

C. All masonry units shall be delivered to site undamaged. Cracked or broken, block with spalled edges or corners, or otherwise defective block shall be rejected by contractor upon delivery and shall not be used in the work.

METHOD OF MEASUREMENT

All MASONRY WALL CONSTRUCTION shown on the plans will be measured for payment on a unit price per square foot.

BASIS OF PAYMENT

This work will be paid for at the contract unit price per SQUARE FOOT for MASONRY WALL CONSTRUCTION.

CLOSED CIRCUIT TELEVISION CABINET

PART 1 - GENERAL

1.1 This specification sets forth the minimum requirements for a TS2 Type 1 traffic control modular cabinet assembly. The cabinet assembly shall meet, as a minimum, all applicable sections of the NEMA Standard Publication No. TS2-2003. Where differences occur, this specification shall govern.

PART 2 - CABINET DESIGN AND CONSTRUCTION

1.1. The cabinet shall be constructed from type 5052-H32 aluminum with a minimum thickness of 0.125 inches.
1.2. The cabinet shall be designed and manufactured with materials that will allow rigid mounting, whether intended for pole, base or pedestal mounting. The cabinet must not flex on its mount.
  1.2.1. A rain channel shall be incorporated into the design of the main door opening to prevent liquids from entering the enclosure. The cabinet door opening must be a minimum of 80 percent of the front surface of the cabinet. A stiffener plate shall be welded across the inside of the main door to prevent flexing.
  1.2.2. The top of the cabinet shall incorporate a 1-inch slope toward the rear to prevent rain accumulation.
1.3. Unless otherwise specified, the cabinet shall be supplied with a natural aluminum finish. Sufficient care shall be taken in handling to ensure that scratches are minimized. All surfaces shall be free from weld flash. Welds shall be smooth, neatly formed, free from cracks, blowholes and other irregularities. All sharp edges shall be ground smooth.
1.4. Where painted cabinets are specified, the exterior shall be degreased and primed with a spray applied iron phosphate coat- equivalent to a four-stage iron phosphate coat prior to painting. The final coat shall consist of a powder coat paint (TGIC or equivalent) applied with a minimum thickness of 2 mils.
1.5. All seams shall be sealed with RTV sealant or equivalent material on the interior of the cabinet.
1.6. All cabinets shall be supplied with a minimum of one removable shelf manufactured from 5052-H32 aluminum. Shelf shall be a minimum of 10 inches deep.
1.7. The shelf shall have horizontal slots at the rear and vertical slots at the front of the turned down side flange. The shelf shall be installed by first inserting the rear edge of the shelf on the cabinet rear sidewall mounting studs, then lowering the shelf on the front sidewall mounting studs. The shelf shall be held in place by a nylon tie-wrap inserted through holes on the front edge of the shelf and around the front sidewall mounting studs.
1.8. The front edge of the shelf shall have holes punched every 6 inches to accommodate tie-wrapping of cables/harnesses.
1.9. A minimum of one set of vertical "C" channels shall be mounted on each interior wall of the cabinet for the purpose of mounting the cabinet components. The channels shall accommodate spring mounted nuts or studs. All mounting rails shall extend to within 7 inches of the top and bottom of the cabinet. Sidewall rail spacing shall be 7.88 inches center-to-center. Rear wall rail spacing shall be 18.50 inches center-to-center.
1.10. The main door and police door-in-door shall close against a weatherproof and dust-proof, closed-cell neoprene gasket seal. The gasket material for the main door shall be a minimum of 0.250 inches thick by 1.00 inch wide. The gasket material for the police door

shall be a minimum of 0.250 inches thick by 0.500 inches wide. The gaskets shall be permanently bonded to the cabinet.

1.11. The lower section of the cabinet shall be equipped with a louvered air entrance. The air inlet shall be large enough to allow sufficient air flow per the rated fan capacity. Louvers must satisfy the NEMA rod entry test for 3R ventilated enclosures. A non-corrosive, vermin- and insect-proof, removable air filter shall be secured to the air entrance. The filter shall fit snugly against the cabinet door wall.

1.12. The roof of the cabinet shall incorporate an exhaust plenum with a vent screen. Perforations in the vent screen shall not exceed 0.125 inches in diameter.

1.13. The main door on a size 3 or larger cabinet shall be equipped with a three-point latching mechanism.

1.14. The handle on the main door of the cabinet shall be manufactured from cast aluminum or stainless steel. The handle shall include a hasp for the attachment of an optional padlock. The cabinet door handle shall rotate counter-clockwise to open. The handle shall not extend beyond the perimeter of the main door at any time. The lock assembly shall be positioned so that the handle shall not cause any interference with the key when opening the cabinet door.

1.15. The main door hinge shall be a one-piece, continuous piano hinge with a stainless steel pin running the entire length of the door. The hinge shall be attached in such a manner that no rivets or bolts are exposed.

1.16. The main door shall include a mechanism capable of holding the door open at approximately 90, 145, and 165 degrees under windy conditions. The main door of a size 3, or 4 cabinet shall include a mechanism capable of holding the door open at approximately 90 and 165 degrees under windy conditions. May be provided with two doors, one front, one back.

1.17. The main door shall be equipped with a Corbin tumbler lock number 1548-1 or exact equivalent. Minimum of two keys shall be supplied.

1.18. The police door-in-door shall be provided with a treasury type lock Corbin No. R357SGS or exact equivalent and has a minimum of one key.

1.19. All base mounted cabinets require anchor bolts to properly secure the cabinet to its base. The cabinet flange for securing the anchor bolts shall not protrude outward from the bottom of the cabinet. When a size 3, 4, or 5 cabinet is base mounted, two anchor bolts shall be required for proper installation. Size 6 and 7 cabinets, four anchor bolts shall be required for proper installation.

1.20. Each cabinet shall be of sufficient size to accommodate all equipment. At a minimum, the minimal cabinet sizes are as follows:

- Size 3 cabinets - 40" H x 24" W x 15" D
- Size 4 cabinets - 46" H x 24" W x 16" D
- Size 5 cabinets - 48" H x 30" W x 16" D
- Size 6 cabinets - 52" H x 44" W x 24" D
- Size 7 cabinets - 72" H x 44" W x 24" D

1.21. Main door shall incorporate a shroud to cover the filtered louvered openings as appropriate for the design. The assembly is secured on the interior of the door over the filtered Louvers. The Shroud is louvered downward and matches the door louvers.

1.22. All enclosures must be constructed, approved and marked in accordance with the requirements for Type 1 Industrial Control Panel Enclosures contained in UL 508A, the Standard for Industrial Control Panels. Enclosure must meet NEMA 3R rating requirements and be marked with UL approval sticker.

PART 3 - TRAFFIC SIGNAL TYPE IV CABINET SPECIFICATIONS

3.1. This work shall be in accordance with Sections 857, 1073, and 1074 of the Standard Specifications except as modified herein. The controller and cabinet shall be compliant with NEMA TS-2 standards and NTCIP standards 1201 and 1202.
3.2. The main panel shall be constructed from 5052-H32 brushed aluminum of 0.125 inches minimum thickness and installed so as to minimize flexing when plug-in components are installed.
3.3. All 8-, 12- and 16-position main panels are provided with a mounting mechanism which allows easy access to all wiring on the rear of the panel. Lowering of the main panel can be accomplished without the use of hand tools. Complete removal can be accomplished by the use of simple hand tools.
3.4. The terminals and facilities shall be available as a minimum in the following configurations:
    a. Configuration - Sixteen load switch sockets, six flash transfer relay sockets, one flasher socket, 2- BIU sockets, one 16-channel detector rack with one BIU, and one Type-16 MMU.
3.5. All load switch and flash transfer relay socket reference designators shall be silk-screen labeled on the front and rear of the main panel to match drawing designations. Socket pins shall be marked for reference on the rear of the panel.
3.6. A maximum of eight load switch sockets may be positioned horizontally or stacked in two rows on the main panel. Main panels requiring more than eight load switch sockets shall be mounted in one horizontal row.
3.7. All load switches shall be supported by a bracket, extending at least half the length of the load switch.
3.8. The 12- and 16-load switch position main panels shall have all field wires contained on two rows of horizontally mounted terminal blocks. The upper row shall be wired for the pedestrian and overlap field terminations. The lower row shall be reserved for phase one through phase eight vehicle field terminations.
3.9. As an alternate a 12 or 16 position horizontal main panel and field terminal configuration may be used.
3.10. All field output circuits shall be terminated on a non-fused barrier type terminal block with a minimum rating of 10 amps.
3.11. All field input/output (I/O) terminals shall be identified by permanent alphanumerical labels. All labels shall use standard nomenclature per the NEMA TS2 specification.
3.12. It shall be possible to flash either the yellow or red indication on any vehicle movement and to change from one color indication to the other by use of a screwdriver.
3.13. Field terminal blocks shall be wired to use four positions per vehicle or overlap phase (green, yellow, and red, flash). It shall not be necessary to de-buss field terminal blocks for flash programming.
3.14. The main panel shall contain at least one flasher socket (silk screen labeled) capable of operating a 15-amp, 2-pole, NEMA solid-state flasher. The flasher shall be supported by a bracket, extending at least half its length.
3.15. One RC network shall be wired in parallel with each group of three flash-transfer relays and any other relay coils.
3.16. All logic-level, NEMA-controller and Malfunction Management Unit input and output terminations on the main panel shall be permanently labeled. Cabinet prints shall identify the function of each terminal position.
3.17. At a minimum, three 20-position terminal blocks shall be provided at the top of the main panel to provide access to the controller unit's programmable and non-programmable

I/O. Terminal blocks for DC signal interfacing shall have a number 6-32 x 7/32 inch screw as minimum.

3.18. All main panel wiring shall conform to the following wire size and color:
- Green/Walk load switch output - brown wire - 14 gauge
- Yellow load switch output - yellow wire - 14 gauge
- Red/Don't Walk load switch - red wire output - 14 gauge
- MMU (other than AC power) - violet wire - 22 gauge
- Controller I/O - blue wire - 22 gauge
- AC Line (power panel to - black wire main panel) - 8 / 10 gauge
- AC Line (main panel) - black wire - 10 gauge
- AC Neutral (power panel to - white wire main panel) - 8 / 10 gauge
- AC Neutral (main panel) - white wire - 10 gauge
- Earth ground (power panel) - green wire - 8 gauge
- Logic ground - gray wire - 22 gauge
- Flash programming - Orange wire
- Flasher terminal - Black wire red or yellow field terminal - 14 gauge

3.19. All wiring, 14 AWG and smaller, shall conform to MIL-W-16878/1, type B/N, 600V, 19-strand tinned copper. The wire shall have a minimum of 0.010 inches thick PVC insulation with clear nylon jacket and rated to 105 degrees Celsius. All 12 AWG and larger wire shall have UL listed THHN/THWN 90 degrees Celsius, 600V, 0.020 inches thick PVC insulation and clear nylon jacketed.

3.20. Connecting cables shall be sleeved in a braided nylon mesh or poly-jacketed. The use of exposed tie-wraps or interwoven cables is unacceptable.

3.21. All Terminals and Facilities configurations shall be provided with BIU wiring assignments consistent with NEMA TS2-1998 specifications.

3.22. All Terminals and Facilities configurations shall be provided with sufficient RS-485 Port 1 communication cables to allow for the intended operation of that cabinet. Each communication cable connector shall be a 15-pin metal shell D subminiature type. The cable shall be a shielded cable suitable for RS-485 communications.

3.23. All main panels shall be pre-wired for a Type-16 Malfunction Management Unit.

3.24. All wiring shall be neat in appearance. All cabinet wiring shall be continuous from its point of origin to its termination point. Butt type connections/splices are not acceptable.

3.25. All connecting cables and wire runs shall be secured by mechanical clamps. Stick-on type clamps are not acceptable.

3.26. The grounding system in the cabinet shall be divided into three separate circuits (AC Neutral, Earth Ground, and Logic Ground). These ground circuits shall be connected together at a single point as outlined in the NEMA TS2 Standard.

3.27. The main panel shall incorporate a relay, designated as K1, to remove +24 VDC from the common side of the load switches when the intersection is placed into mechanical flash. The relay shall have a momentary pushbutton to apply power to the load switch inputs for ease of troubleshooting. The relay shall have a momentary pushbutton to apply power to the load switch inputs for ease of troubleshooting.

3.28. All pedestrian push button inputs from the field to the controller shall be opto-isolated through the BIU and operate at 12 VAC.

3.29. All wire (size 16 AWG or smaller) at solder joints shall be hooked or looped around the eyelet or terminal block post prior to soldering to ensure circuit integrity. Lap joint soldering is not acceptable.

PART 4 - POWER PANEL DESIGN AND CONSTRUCTION

The power panel shall integrated into the main panel and be located on the lower right portion of the cabinet. The power panel shall be wired to provide the necessary filtered power to the load switches, flasher(s), and power bus assembly. The power components shall be equipped with a removable plastic front cover for technician protection. The design will allow a technician to access the main and auxiliary breakers without removing the protective front cover.

4.1. The power panel portion of the main panel shall include the following components:
   a. A minimum of a 40-amp main breaker for 12- or 16- position cabinets or a minimum of a 30-amp breaker for 4- or 8-position cabinets. This breaker shall supply power to the controller, MMU, signals, cabinet power supply and auxiliary panels. Breakers shall be at minimum, a thermal magnetic type, U.L. listed for HACR service, with a minimum of 10,000 amp interrupting capacity.
   b. A minimum of one (1) 15-amp auxiliary breaker. This breaker shall supply power to the fan, light and GFI utility outlet.
   c. An EDCO model SHP-300-10 or exact approved equivalent surge arrester.
   d. A 50 amp, 125 VAC radio interference line filter.
   e. A normally-open, 75-amp, Solid State Signal buss relay. The SSR shall be a Crydom Model # HA4875H or approved equal.
   f. A minimum of one (1) 8-position neutral bus bar capable of connecting three #12 wires per position.
   g. A minimum of one (1) 6-position ground bus bar capable of connecting three #12 wires per position.
   h. A minimum of one (1) NEMA type 5-15R GFI utility outlet.
   i. The cabinet shall be equipped with additional surge protection for the controller, malfunction management unit, and detector amplifiers, and/or video detection system. The surge protector shall be a Transtector ACP100BWN3 and shall be included in addition to an EDCO SHA-1250 IRS protector.

PART 5 - POWER BUS ASSEMBLY

The power bus assembly shall be manufactured from 0.090", 5052-H32 aluminum. It shall provide filtered power for the controller, malfunction management unit, cabinet power supply, and all auxiliary equipment. It shall include the SDLC Bus connecting cables wired into a surface-mounted terminal block. As an alternate SDLC Bus connections may be made via an SDLC Hub Assembly.

5.1. The Power Bus Assembly shall house the following components:
   a. A minimum of three and a maximum of six power connectors.
   b. Two terminal strips to hardwire the power connections.
   c. SDLC terminal block with pre-wired cables or SDLC Hub Assembly

5.2. All cabinet equipment requiring filtered power to operate shall be connected to the power bus assembly by a 12-pin Molex Robotic Type connector Model# 54332-1270 or exact equivalent or hardwired directly to the supplied terminal blocks.

5.3. An SDLC Hub Assembly shall include a minimum of three and maximum of eight D-Subminiature Female 15 pin (DB15) connectors that are wired in series.

PART 6 - AUXILIARY CABINET EQUIPMENT

The cabinet shall be provided with a thermostatically controlled (adjustable between 55-160 degrees Fahrenheit) ventilation fan in the top of the cabinet plenum. The fan plate shall be removable with the use of simple hand tools for serviceability. A minimum of one exhaust fan shall be provided. The fan shall be a ball bearing type fan and shall be capable of drawing a minimum of 100 cubic feet of air per minute. The Fan/Thermostat assembly shall be connected to the Power panel by means of a 4 position plug-in cable.

6.1. At minimum, a 40-watt incandescent refrigerator lamp and socket mounted on an aluminum bracket shall be mounted in the cabinet to sufficiently illuminate the field terminals. The lamp shall be wired to either a 15-amp ON/OFF toggle switch mounted on the power panel or to a door activated switch mounted near the top of the door.

6.1.1. Alternately, a 40-watt incandescent lamp mounted on a 14-inch flexible arm shall be included. The flexible arm shall be permanently mounted to the middle of the cabinet door. The lamp shall be wired to either a 15-amp ON/OFF toggle switch mounted on the power panel or to a door activated switch mounted near the top of the door.

6.1.2. Alternately, a fluorescent lighting fixture shall be mounted on the inside top of the cabinet near the front edge. The fixture shall be rated to accommodate at minimum a F15T8 lamp operated from a normal power factor UL or ETL listed ballast. The lamp shall be wired to either a 15-amp ON/OFF toggle switch mounted on the power panel or to a door activated switch mounted near the top of the door.

6.1.3. Alternately, an LED cabinet lighting system may be used to illuminate the internal structure of the cabinet assembly. The LED cabinet lighting shall be Luxem Bright LED modules Model#772-W0013 and approved power supply.

6.2. A resealable print pouch shall be mounted to the door of the cabinet. The pouch shall be of sufficient size to accommodate one complete set of folded cabinet prints.

6.3. A minimum of two sets of complete and accurate cabinet drawings shall be supplied with each cabinet.

PART 7 - VEHICLE DETECTION

A minimum of one Loop Detector Rack shall be provided in each cabinet. Detector racks shall be available in two configurations. These configurations shall be integrated on top left side portion of the main panel.

a. Configuration - Shall support up to 16 channels of loop detection (either eight 2 channel detectors or four 4 channel detectors), two 2-channel preemption devices and one BIU. This configuration shall be included as a standard on the 12 or 16 position main panel assembly.

7.1. Detector rack BIU mounting shall be an integral part of the detector rack.

7.2. All BIU rack connectors shall have jumper address pins corresponding to the requirements of the TS2 specification. The jumpers may be moved to change the address of any individual rack. The address pins shall control the BIU mode of operation. BIUs shall be capable of being interchanged with no additional programming.

7.3. Each cabinet shall contain detector interface panels for the purpose of connecting field loops and Loop Detector Racks. The panels shall be manufactured from FR4 G10 fiberglass, 0.062 inches thick, with a minimum of 2 oz. of copper for all traces.

7.4. One 8-position interface panel shall be provided for an 8-channel rack cabinet and one 16-position interface panel shall be provided for a 16-channel rack cabinet. The interface panel shall be secured to a mounting plate and attached to the left wall of the cabinet.
7.5. Each interface panel shall allow for the connection of eight or sixteen independent field loops. A ground bus terminal shall be provided between each loop pair terminal to provide a termination for the loop lead-in cable ground wire.
7.6. Each interface panel shall provide a 10-position terminal block to terminate the field wires for up to two 2-channel preemption devices.
7.7. Lightning protection device mounting holes shall be provided to accommodate an Edco SRA-16C, or Edco SRA-6, or Edco LCA-6, or a varistor lightning protection device. Lightning protection devices shall not be provided unless specifically called for in the special provisions of this specification.
7.8. A cable consisting of 20 AWG twisted pair wires shall be provided to enable connection to and from the panel to a detector rack. The twisted pair wires shall be color coded red and white wire.
7.9. All termination points shall be identified by a unique number and silk screened on the panel.
7.10. Each detector rack shall accommodate rack mountable preemption devices such as EMTRAC or Opticom.
7.11. Each detector rack shall be powered by the cabinet power supply and be connected to the power bus assembly by means of a 12-pin Molex Robotic type connector Model# 54332-1270 or exact equivalent.

PART 8 - CABINET TEST SWITCHES AND POLICE PANEL

A test switch panel shall be mounted on the inside of the main door. The test switch panel shall provide as a minimum the following:

a. SIGNALS ON/OFF SWITCH - In the OFF position, power shall be removed from signal heads in the intersection. The controller shall continue to operate. When in the OFF position, the MMU shall not conflict or require reset.
b. AUTO/FLASH SWITCH - When in the flash position, power shall be maintained to the controller and the intersection shall be placed in flash. The controller shall not be stop timed when in flash. Wired according to NEMA-TS2-2003 the MMU forces the controller to initiate the start-up sequence when existing flash.
c. STOP TIME SWITCH - When applied, the controller shall be stop timed in the current interval.
e. CONTROL EQUIPMENT POWER ON/OFF - This switch shall control the controller, MMU, and cabinet power supply AC power.
Momentary test push buttons for all vehicle and pedestrian inputs to the controller are not required. The TS2 controller to be provided with the cabinet assembly shall provide vehicular and pedestrian call inputs from its keyboard while in the standard status display.

The police door switch panel shall contain the following:

a. SIGNALS ON/OFF SWITCH - In the OFF position, power shall be removed from signal heads in the intersection. The controller shall continue to operate. When in the OFF position, the MMU shall not conflict or require reset.
b. AUTO/FLASH SWITCH – When in the flash position, power shall be maintained to the controller and the intersection shall be placed in flash. The controller shall be stop timed when in flash. Wired according to NEMA-TS2-1998 the MMU forces the controller to initiate the start-up sequence when exiting flash.

All toggle type switches shall be heavy duty and rated 15 amps minimum. Single- or double-pole switches may be provided, as required.
Any exposed terminals or switch solder points shall be covered with a non-flexible shield to prevent accidental contact.
All switch functions must be permanently and clearly labeled.
All wire routed to the police door-in-door and test switch push button panel shall be adequately protected against damage from repetitive opening and closing of the main door.
All test switch panel wiring shall be connected to the main panel via a 50-pin Molex Robotic type connector Model# 54332-5001, or exact equivalent.
Wiring from the main panel to the test switch panel shall be connected to the switch panel via a 30-pin Molex Robotic type connector Model# 54332-3070 or exact equivalent.

PART 9 - AUXILIARY DEVICES

Load Switches

9.1.1. Load switches shall be solid state and shall conform to the requirements of Section 6.2 of the NEMA TS2 Standard.
9.1.2. Signal load switches shall have a minimum rating of 10 amperes at 120 VAC for an incandescent lamp load.
9.1.3. The front of the load switch shall be provided with three indicators to show the input signal from the controller to the load switch.
9.1.4. Load switches shall be dedicated per phase. The use of load switches for other partial phases is not acceptable.
9.1.5. The full complement of load switches shall be supplied with each cabinet to allow for maximum phase utilization for which the cabinet is designed.

Flashers

9.1.6. The flasher shall be solid state and shall conform to the requirements of section 6.3 of the NEMA TS2 Standard.
9.1.7. Flashing of field circuits for the purpose of intersection flash shall be accomplished by a separate flasher.
9.1.8. The flasher shall be rated at 15 amperes, double pole with a nominal flash rate of 60 FPM.

Flash Transfer Relays

9.1.9. All flash transfer relays shall meet the requirements of Section 6.4 of the NEMA TS2 Standard.
9.1.10. The coil of the flash transfer relay must be de-energized for flash operation.
9.1.11. The full complement of relays shall be supplied with each cabinet to allow for maximum phase utilization for which the cabinet is designed.

Malfunction Management Units (MMU)

9.1.12. Each cabinet assembly shall be supplied with one MMU as defined by the requirements of Section 4 of the NEMA TS2 Standard.
9.1.13. Malfunction Management Units shall be a Type 16. The MMU shall be Econolite Control Products, Inc. Model MMU-16 (EDI Model MMU-16) or approved equal.

Bus Interface Units (BIU)

9.1.14. All BIUs shall meet the requirements of Section 8 of the NEMA TS2 Standard.

9.1.15. The full complement of Econolite Control Products, Inc. Model 32860G1 Bus Interface Units shall be supplied with each cabinet to allow for maximum phase and function utilization for which the cabinet is designed.

9.1.16. Each Bus Interface Unit shall include power on, transmit and valid data indicators. All indicators shall be LEDs.

Cabinet Power Supply

9.1.17. The cabinet power supply shall meet the requirements of Section 5.3.5 of the NEMA TS2 Standard.

9.1.18. The cabinet power supply shall provide LED indicators for the line frequency, 12 VDC, 12 VAC, and 24 VDC outputs.

9.1.19. The cabinet power supply shall provide (on the front panel) jack plugs for access to the +24 VDC for test purposes.

9.1.20. One Econolite Control Products, Inc. Model 1084-003 cabinet power supply shall be supplied with each cabinet assembly and shall be wired directly to the Power Bus Assembly via a 12-pin Molex Robotic type connector Model# 54332-1270or exact equivalent.

PART 10 - TESTING AND WARRANTY

Testing

10.1.1. Each controller and cabinet assembly shall be tested as a complete entity under signal load for a minimum of 48 hours.

10.1.2. Each assembly shall be delivered with a signed document detailing the cabinet final tests performed.

10.1.3. The cabinet shall be assembled and tested by the controller manufacturer or authorized local distributor to ensure proper component integration and operation.

Warranty

10.1.4. The controller and Malfunction Management Unit shall be warranted by the manufacturer against mechanical and electrical defects for a period of two years from date of shipment. The manufacturer's warranty shall be supplied in writing with each cabinet and controller. Second party extended warranties are not acceptable.

10.1.5. The cabinet assembly and all other components shall be warranted for a period of one year from date of shipment.

10.1.6. Any defects shall be corrected by the manufacturer or supplier at no cost to the owner.

BASIS OF PAYMENT

This item shall be paid at the contract unit price per EACH for CLOSED CIRCUIT TELEVISION CABINET.

CLOSED-CIRCUIT TELEVISION DOME CAMERA

Description. This work shall consist of furnishing and installing an integrated Closed-Circuit Television (CCTV) Dome Camera Assembly, camera brackets, and all other items required for installation and operation. This assembly shall contain all components identified in the Materials Section and shall be configured as indicated on the plan sheets.

Materials.

The CCTV camera shall be an Axis Model Q6055-E Dome Camera Assembly for integration into the existing ITS system.

The Contractor shall provide all materials required to install the proposed camera on the proposed light pole at the locations shown on the plan sheets. The light pole will be paid separately as **"LIGHT POLE, STEEL 50 FT. WITH CAMERA LOWERING SYSTEM".**

The Contractor shall submit catalog cut sheets to the Department for all items (mounting brackets, hardware, etc.) that will be utilized for review prior to commencing work.

The camera shall meet or exceed the following specifications:

Camera

Video:	60 Hz (NTSC), 50 Hz (PAL)
Image Sensor	¼" ExView HAD Progressive Scan CCD
Lens:	3.4 – 119 mm, F1.4 – 4.2, autofocus, automatic day/night, horizontal angle of view: 1.7° - 55.8°
Minimum Illumination:	Color: 0.5 lux at 30 IRE, B/W: 0.008 lux at 30
IRE Shutter Time (NTSC):	1/30 000 s – 0.5 s, PAL: 1/30 000 s – 1.5 s
Pan/Tilt/Zoom:	E-flip, 100 preset positions
	Pan: 360° endless, 0.05 – 450°/s
Tilt:	220°, 0.05 – 450°/s
Zoom:	35x optical zoom and 12x digital zoom, total 420x zoom
	Guard tour Control queue

Video

Video:	H.264 (MPEG-4 Part 10/AVC), Motion JPEG
Resolutions:	NTSC: 704x480 to 176x120, PAL: 704x576 to 176x144
Frame rate (H.264):	Up to 30/25 (NTSC/PAL) fps in all resolutions
Frame rate (M-JPEG):	Up to 30/25 (NTSC/PAL) fps in all resolutions
Video streaming:	Multi-stream H.264 and Motion JPEG: 3 simultaneous, individually configured streams in max. resolution at 30/25 (NTSC/PAL) fps;

	more streams if identical or limited in frame rate/resolution; Controllable frame rate and bandwidth; VBR/CBR H.264
Image setting:	Wide Dynamic Range (WDR), Electronic Image Stabilization (EIS), manual shutter time, compression, color, brightness, contrast, sharpness, rotation, aspect ratio correction, Text and image overlay, privacy mask, image freeze on PTZ

Network

Security:	Password protection, IP address filtering, HTTPS* encryption, IEEE 802.1X* network access control, digest authentication, user access log
Protocols:	IPv4/v6, HTTP, HTTPS*, QoS Layer 3 DiffServ, FTP, SMTP, Bonjour,UPnP, SNMPv1/v2c/v3 (MIB-II), DNS, DynDNS, NTP, RTSP, RTP,TCP, UDP, IGMP, RTCP, ICMP, DHCP, ARP, SOCKS

System Integration

Application Programming	Open API for software integration, including VAPIX® from Axis Interface: Communications available at www.axis.com
Intelligent video:	Video motion detection, auto-tracking
Alarm triggers:	Intelligent video, PTZ position
Alarm events:	File upload via FTP, HTTP and email, Notification via email, HTTP and TCP PTZ position, Local storage
Video buffer:	56 MB pre- and post-alarm

General

Casing:	IP66-rated, metal casing (aluminum), acrylic (PMMA) clear dome cover pre-mounted to casing, sunshield (polycarbonate)
Processors and Memory:	ARTPEC-3, 128 MB RAM, 128 MB Flash
Power Camera:	High Power over Ethernet, max. 50 W, Midspan (included): AXIST8124 High Power over Ethernet, Midspan 1-port 100-240 V AC, max. 60 W
Connectors:	RJ-45 for 10BASE-T/100BASE-TX, IP66-rated RJ-45 connector kit included
Local storage:	SD/SDHC memory card slot (Card is not included)
Operating Conditions:	Camera unit: -40 °C to 50 °C (-40 °F to 122 °F), Arctic Temperature Control enables camera start-up at temperatures as low as -40 °C (-40 °F)

Approvals:	EN 55022 Class B, EN 55024, EN 61000-3-2, EN 61000-3-3, EN61000-6-1, EN 61000-6-2, FCC Part 15 Subpart B Class B, VCCI Class B, C-tick AS/NZS CISPR22, ICES-003 Class B, EN 60950-1, Midspan: EN 60950-1, GS, UL, cUL, CE
Weight	3.5 kg (7.7 lb.)
Included Accessories:	AXIS T8124 High PoE Midspan 1-port, IP66-rated RJ-45 connector kit, clear and smoked dome cover, sunshield, Installation Guide, CD with User's Manual, recording software, installation and management tools, Windows decoder 1-user license

Environmental Enclosure/Housing

The environmental enclosure shall be designed to physically protect the integrated camera from the outdoor environment and moisture via a sealed enclosure. If the option exists in the standard product line of the manufacturer, the assembly shall be supplied with an integral sun shield. The enclosure shall be fully water and weather resistant with a NEMA 4 rating or better.

The camera dome shall be constructed of distortion free acrylic or equivalent material that must not degrade from environmental conditions. The environmental housing shall include a camera-mounting bracket. In addition, the environmental housing shall include a heater, blower, and power surge protector. An integral fitting compatible with a standard 1-1/2 in (38.1 mm) NPT pipe, suitable for outdoor pendant mounting shall also be provided.

The enclosure shall be equipped with a heater controlled by a thermostat. The heater shall turn on when the temperature within the enclosure falls below 40 F (4.4 C). The heater shall turn off when the temperature exceeds 60 F (15.6 C). The heater will minimize internal fogging of the dome faceplate when the assembly is operated in cold weather.

In addition, a fan shall be provided as part of the enclosure. The fan will provide airflow to ensure effective heating and to minimize condensation.

The enclosure shall be equipped with a hermetically sealed, weatherproof connector, located near the top for external interface with power, video, and control feeds.

CCTV Dome Camera Mounting Supports

The Contractor shall furnish and install an Axis Pole Mount Bracket T91A67 (Part Number 5017-671) for camera installation on CCTV camera poles.

Mounting supports shall be configured as shown on the camera support detail plans and as approved by the Engineer. Mount shall be of aluminum construction with enamel or polyester powder coat finish. Braces, supports, and hardware shall be stainless steel. Wind load rating shall be designed for sustained gusts up to 90 mph (145 km/hr), with a 30% gust factor. Load rating shall be designed to support up to 75 lb (334 N). For roof or structural post/light pole mounting, mount shall have the ability to swivel inward for servicing. The mounting flange shall use standard 1-1/2 inch (38.1 mm) NPT pipe thread.

Connecting Cables and Power Supply

The Contractor shall provide outdoor rated, CAT 6E cable. One cable shall be installed from the proposed control cabinet to the proposed camera mounting location as shown on the plan sheets. Both cables shall be terminated with IP66-rated RJ-45 connectors. This cable will be paid for separately under the pay item for **CAT. 6 ETHERNET CABLE**.

The High POE midspan camera power supply (included with camera) shall be installed in the proposed traffic signal cabinet. The Contractor shall furnish and install one 15A power strip with integral surge protection in the traffic signal cabinet for camera power.

This cabinet will be paid for separately under the pay item for **CLOSED CIRCUIT TELEVISION CABINET**

Power Strip

The cabinet power strip shall have a minimum of six outlets and integral surge suppression that meets or exceeds the following minimum specifications:

- Let Through Voltage: <85 Volts
- Operating Voltage: 120VAC, 50/60H
- UL Suppressed Voltage Rating: 330V
- Energy Rating: 320J
- Peak Current NM/CM: 13k Amps NM, 13k Amps CM
- EMI/RFI Noise Filtration: >25-60dB

The power strip shall be wired directly to the protected power terminals on the cabinet surge arrestor. The Contractor shall provide all materials required for installation.

This work shall be included in the contract bid price for the CCTV camera pay item.

CONSTRUCTION REQUIREMENTS.

General

The Contractor shall prepare a shop drawing detailing the complete CCTV Dome Camera Assembly and installation of all components to be supplied for approval of the Engineer. Particular emphasis shall be given to the cabling and the interconnection of all of the components.

The Contractor shall install the CCTV dome camera assembly at the locations indicated in the Plans.

Programming and Testing

The Department will program and test each camera prior to installation. The Department will connect the proposed CCTV camera to the existing ITS network Ethernet switch and integrate the camera into the existing ITS video subsystem.

Method of Measurement. The closed circuit television dome camera bid item will be measured for payment by the actual number of CCTV dome camera assemblies furnished, installed, tested, and accepted.

Basis of Payment. Payment will be made at the contract unit price per EACH for **CLOSED CIRCUIT TELEVISION DOME CAMERA** including all equipment, material, testing, documentation, and
labor detailed in the contract documents for this bid item.

CAT 6 ETHERNET CABLE

This work shall be in accordance with Sections 873, 1076, and 1088 of the Standard Specifications except as modified herein.

This work shall consist of furnishing and installing an outdoor rated CAT5E cable in the proposed conduits and pole. The cable shall be rated for outdoor use and conform to the following specifications:

- Outdoor CMX Rated Jacket (climate/oil resistant jacket)
- UV Resistant Outer Jacket Material (PVC-UV, UV Stabilized)
- Outer Jacket Ripcord
- Designed For Outdoor Above- Ground or Conduit Duct applications
- Cat5E rated to 350MHz (great for 10/100 or even 1000mbps Gigabit Ethernet)
- Meets TIA/EIA 568b.2 Standard
- UTP, Unshielded Twist Pair
- 4 Pairs, 8 Conductors
- 24AWG, Solid Core Copper
- UL 444 ANSI TIA/EIA-568.2 ISO/IEC 11801
- RoHS Compliant

The Contractor shall purchase pre-terminated cable assemblies and utilize them whenever possible to minimize potential cable and connector problems. The pre-assembled cable assemblies shall be rated for outdoor use and be terminated with IP66 rated RJ-45 connectors.

In the event that a pre-assembled cable is not used, the Contractor shall terminate each end of the cable with an IP66 rated RJ-45 connector or utilizing connector kits furnished with the CCTV dome camera. The Contractor shall terminate the cable assembly in an environmentally controlled area and test the cable and connectors prior to installing the cable in the field.

The Department will inspect and test each cable assembly.

The Contractor shall submit catalog cut sheets to the Department for review prior to commencing work.

Basis of Payment: This work will be paid for at the contract unit price per FOOT for CAT 6 ETHERNET CABLE, which shall be payment in full for all labor, equipment, and materials required to provide and install the cable described above, complete.

LIGHT POLE, STEEL 50 FT. WITH CAMERA LOWERING SYSTEM

GENERAL DESCRIPTION

LIGHT POLE

This work shall consist of furnishing, erecting, and installing a steel light pole with camera lowering system and accessories, and pole foundation in accordance with Section 830 of the Standard Specifications, as detailed in the plans, and as directed by the Engineer.

CAMERA

The camera lowering system shall be designed to support and lower an Ethernet/IP closed circuit television camera, lens, housing, PTZ mechanism, cabling, connectors and other supporting field components without damage or causing degradation of camera operations. The lowering system shall consist of a lowering device with the mounting slot and bolt hole mirrored on 180 degrees of the pole top tenon. The system shall include the suspension contact unit, divided support arm, and a pole adapter for attachment to a pole top tenon, pole top junction box, conduit mount adapter and camera connection box. The divided support arm and receiver brackets shall be designed to self-align the contact unit with the pole center line during installation and ensure the contact unit cannot twist under high wind conditions. For maximum arm strength, round support arms are not acceptable. The camera-lowering device shall withstand wind forces of 100mph with a 30 percent gust factor using a 1.65 safety factor. The lowering device manufacturer, upon request, shall furnish independent laboratory testing documents certifying adherence to the stated wind force criteria utilizing, as a minimum effective projected area (EPA), the actual EPA or an EPA greater than that of the camera system to be attached. The camera-lowering device to be furnished shall be the product of manufacturers with a minimum of 5 years of experience in the successful manufacturing of camera lowering systems. The lowering device provider shall be able to identify a minimum of 3 previous projects where the purposed system has been installed successfully for over a one-year period of time each.

The lowering device Manufacturer shall furnish an authorized factory representative to oversee the installation Contractor's assembly and testing of the first lowering system onto the pole assembly. The Manufacturer shall furnish the Engineer documentation certifying that the installation Contractor has been instructed on the installation, operation and safety features of the lowering device for the particular project. The Contractor shall be responsible for providing applicable maintenance personnel "on site" for operational instructions.

SUSPENSION CONTACT UNIT & CONTACT BLOCK

The suspension contact unit shall have a load capacity 600 lbs. with a 4 to 1 safety factor. There shall be a locking mechanism between the fixed and moveable components of the lowering device. The movable assembly shall have a minimum of 2 latches. This latching mechanism shall securely hold the device and its mounted equipment. The latching mechanism shall operate by alternately raising and lowering the assembly using the winch and lowering cable. When latched, all weight shall be removed from the lowering cable. The fixed unit shall have a heavy duty cast tracking guide and means to allow latching in the same position each time. The contact unit housing shall be weatherproof with a gasket provided to seal the interior from dust and moisture. The entire unit shall have a minimum temperature rating of -40 degrees F to +190 degrees F (-40C to 90C).

The prefabricated components of the lift unit support system shall be designed to preclude the lifting cable from contacting the power or video cabling. The lowering device manufacturer shall provide conduit mount adapters for housing the lowering cable. These adapters shall have an interface to allow the connection of a Contractor provided 1.25 inch PVC conduit and be located just below the cable stop block at the back of the lowering device. The Contractor shall supply internal conduits in the pole as directed by the Lowering Device provider. The only cable permitted to move within the pole or lowering device during lowering or raising shall be the stainless steel lowering cable. All other cables must remain stable and secure during lowering and raising operations.

The Lowering Device must be specifically equipped with electrical contacts connectors designed for an Ethernet (IP-CAT5e) video transmission along with PTZ control. The contact connectors shall be designed for extreme environmental outdoor use.

The female and male socket contact halves of the connector block shall be made of a UL94, V-0 rated thermosetting synthetic rubber. The female barrel contacts and the male pin contacts shall be permanently and integrally encased in this rubber material to ensure optimum protection from moisture and the environment.

All current carrying male pin and female socket/barrel contacts shall be Gold-plated per ASTM B-488 over Nickel plated CA 360 per QQ-N-290m.

The Ethernet configuration contact connector shall include:

Each IP/Ethernet Male-Female connector shall include a total of (13) specifically designed male contacts sized a minimum of 0.09 inches while the female contacts shall be at least 0.09 inches I.D. at the contact area. Eight of the thirteen contacts shall be soldered to CAT5e wire end and terminated with an RJ45-Male connector. Five of the thirteen contacts shall be soldered to #18/1 UL lead wire and affixed with numbered tags, which may be used for additional camera requirements including but not limited to power, control, alarms or grounds.

All current carrying male pin and female socket/barrel contacts shall be Gold-plated per ASTM B-488 over Nickel plated CA 360 per QQ-N-290m. Each individual female barrel contact shall have a Nickel plated CA 360 sleeve which prevents foreign matter from entering the contact area as well as preclude the possibility of the leaves of the female contact from opening beyond allowable limits and ensure a snug fit around the respective male pins. There shall be at least one contact that is positioned in a manner which will allow it to make first and break last providing optimum grounding performance.

All soldering shall be per IPC J STD-001E. Each individual contact shall be rated for up to 600v and 7A but de-rated according to the wire used in the application. For optimum weatherproofing, each male contact shall be self-wiping with a shoulder at the base of each male contact so that it will recess into the female block, thereby giving a rain-tight seal to each individual contact when mated. Further, the wire leads from both the male and female rubber contact blocks shall be permanently and integrally molded in the synthetic rubber body. The facility manufacturing the electrical contact connector must comply with Mil Spec Q-9858 and Mil Spec I-45208.

LOWERING TOOL

The camera-lowering device shall be operated by use of a portable lowering tool. The tool shall consist of a lightweight metal frame and winch assembly with factory spooled stainless steel aircraft cable, a quick release cable connector, an adjustable safety clutch and a variable speed industrial duty electric drill motor. This tool shall be compatible with accessing the support cable through the hand hole of the pole. The lowering tool shall attach/secure to the pole with one single bolt. The tool will support itself and the load during lowering/raising operations. The winch assembly shall include an automatic breaking system that provides a means to prevent freewheeling when loaded. The lowering tool shall be delivered to the Engineer upon project completion. The lowering tool shall have a reduction gear to reduce the manual effort required to operate the lifting handle to raise and lower a capacity load. The lowering tool shall be provided with an adapter for operating the lowering device by a portable drill using a clutch mechanism. The lowering tool shall be equipped with a positive breaking mechanism to secure the cable reel during raising and lowering operations and prevent freewheeling. The manufacturer shall provide a variable speed, heavy-duty reversible drill motor, clutch and one lowering tool for every ten camera lowering device poles. The lowering tool shall be made of durable and corrosion resistant materials, powder coated steel, galvanized steel, heavy duty aluminum or otherwise protected from the environment by industry-accepted coatings to withstand exposure to a corrosive environment.

CAMERA JUNCTION BOX

The camera junction box is essential for proving both a mounting location for the CCTV as well as an interface compartment for wire leads from the lowering device to the CCTV or applicable surge suppression module. The camera junction box shall be of two piece clamshell design with one removable hinge side and one latch side with single toggle bolt to facilitate easy access. The general shape of the box shall be cylindrical to minimize the effective projected area. The camera junction box shall be cast aluminum with stabilizing weights on the outside of the box to increase room on the interior. The box shall be capable of having up to 40 pounds of stabilizing weights. The bottom of the camera junction box shall be drilled and tapped with a 1-1/2" NPT/Female thread to accept industry standard dome housings and be able to be modified to accept a wide variety of other camera mountings. The junction box shall be gasketed to prevent water intrusion. The bottom of the box shall incorporate a screened and vented hole to allow airflow and reduce internal condensation.

MATERIALS

All pulleys for the camera lowering device and portable lowering tool shall have sealed, self-lubricated bearings, oil tight bronze bearings, or sintered-oil impregnated, bronze bushings. The lowering cable shall be a minimum 1/8-inch diameter stainless steel aircraft cable with a minimum breaking strength of 1740 pounds with (7) strands of 19 wire each.

All electrical and video coaxial connections between the fixed and lowerable portion of the contact block shall be protected from exposure to the weather by both a gasket on the bottom side of the bell housing enclosure as well as the "O" ring shoulders at the base of each male contact pin to prevent degradation of the power/signal contacts.

The interface and locking components shall be made of stainless steel and/or aluminum. All external components of the lowering device shall be made of corrosion resistant materials, powder coated, galvanized, or otherwise protected from the environment by industry-accepted coatings to withstand exposure to a corrosive environment.

In the event the CCTV is a non-dome or otherwise not properly weight balanced and plumb, the Camera Manufacturer shall provide weights and /or counterweights as necessary to assure that the alignment of pins and connectors are proper for the camera support to be raised into position without binding.

The Contractor shall provide applicable power/signal connectors and weatherproof interface couplers for attachment to the bare leads and RJ-45 male contacts in the pole top and/or camera junction boxes in a manner acceptable to the Engineer.

The Contractor shall provide appropriate length of applicable power/signal cable in one continuous run from the respective equipment cabinet to the pole top junction box of each lowering device pole.

BASIS OF PAYMENT

This item shall be paid at the contract unit price per EACH for LIGHT POLE, STEEL 50 FT. WITH CAMERA LOWERING SYSTEM**.**

FIBER OPTIC UTILITY MARKER

Marking of the Fiber Optic In-ground conduit runs will be done to prevent future damage to the fiber backbone. The markers will be placed every 300 feet along the fiber run and at other important junctions, turns, or other areas as specified by the field engineer.

The markers shall adhere to the following minimum specifications:

The marker shall be a cylindrical marker mounted on a 3.5” O.D. post.

The marker shall be comprised of polymer materials which are resistant to impact, ultraviolet light, ozone, or hydrocarbon damage. The post and marker shall remain impact resistant in temperatures of -20 degrees to 140 degrees F.

The marker shall incorporate a cylindrical tube construction. It shall be capable of permanent or temporary installation on a 3.5” O.D. tube and shall utilize an anchor barb below ground level to prevent rotation and removal. The marker shall have an outside diameter of 3.82 inches. The nominal wall thickness shall be 0.13 inches and the overall length shall be 18 inches.

The marker shall be colored red on top of orange. Red shall be from the top to halfway down the marker (9 inches) and then orange the remaining 9 inches. The marker shall be pigmented throughout its entire cross section and shall incorporate UV resistant materials to prevent fading or cracking in outdoor environments.

The marker graphics shall include the following:

On the red portion of the marker in the vertical direction it shall say “Buried Cables” above the symbol for “no digging”. It shall have the same verbiage on the opposite side (180 degrees away). Ninety degrees (90O) from this, on both sides, shall be the verbiage “Danger”, also in the vertical direction.

The orange portion of the marker, in the horizontal direction and on two sides of the Marker, shall incorporate the IDOT logo and the words, 'Illinois Department of Transportation". Directly below this it shall say, "Intelligent Transportation System". Below this, it shall say, "Before digging, trenching, or pushing pipe in this vicinity, call 618-346-3233. Failure to comply will result in Legal Action." Directly below this, a horizontal line and then "MARKER ID NUMBER" with a blank space for the marker id number to be inserted in the field. The Contractor shall be responsible for adding the MARKER ID NUMBER based on the following template:

557007.84.01F

Where:

5570 = Interstate Designation
07.84 = Milepost number to nearest hundredth of mile
01 = Marker number
F = Fiber Marker

Directly below this again include the symbol for "no digging" and the words "Buried Cable". All graphics shall consist of a solvent-based ink that is abrasive and UV resistant.

The marker shall exhibit good workmanship and shall be free of burns, discoloration, and other objectionable marks or defects, which affect appearance or serviceability.

The marker shall have a minimum tensile strength of 2700 pounds per square inch, as measured by ASTM D638 (specimen Type I with separation rate of two inches per minute). The marker tensile strength shall not deviate more than 10 percent from the standard room temperature result when tested at both 140 degrees and -20 degrees F after a minimum of two hours conditioning at the respective temperature.

The marker shall be a six foot post with an 18" marker attached and installed to a two foot burial depth. It shall be capable of withstanding at least one vehicle impact at 35 mph. The marker shall return upright within 15 degrees of vertical position within a maximum of 30 seconds from the time of impact. The warning legend shall be retained on the marker after each impact.

GPS Coordinates for every line marker placed will be measured. **The coordinates shall be measured in geographic decimal degrees and recorded in a table provided to IDOT in both electronic and hard copy format.** GPS coordinate data collection shall continue to fiber termination points at controller cabinets and to the TMC so all conduit and fiber runs are clearly identified. The conduit, fiber markers and controller cabinets shall be located with an accuracy level of eighteen (18) inches. The fiber optic utility markers, conduit and controller cabinets shall be distinguishable in the GPS locator device as they are collected, so they are clearly identified in the table provided to the Department.

This work shall be paid for at the contract unit price per EACH for **FIBER OPTIC UTILITY MARKER**.

REMOVAL AND DISPOSAL OF REGULATED SUBSTANCES

Description. This work shall consist of the removal and disposal of regulated substances according to Section 669 of the Standard Specifications as revised below.

The qualified on-site monitoring personnel performing work shall have a minimum of one-year experience in similar activities as those required for the project and shall meet Section 669 of the Standard Specifications for Road and Bridge Construction requirements

Contract Specific Work Areas. The excavated soil and groundwater within the work areas listed below shall be managed as either "uncontaminated soil", hazardous waste, special waste or non-special waste. For stationing, the lateral distance is measured from centerline and the farthest distance is the offset distance or construction limit, whichever is less.

Soil Disposal Analysis. When the waste material requires sampling for landfill disposal acceptance, the Contractor shall secure a written list of the specific analytical parameters and analytical methods required by the landfill. The Contractor shall collect and analyze the required number of samples for the parameters required by the landfill using the appropriate analytical procedures. A copy of the required parameters and analytical methods (from landfill email or on landfill letterhead) shall be provided as Attachment 4A of the BDE 2733 (Regulated Substances Final Construction Report). The price shall include all sampling materials and effort necessary for collection and management of the samples, including transportation of samples from the job site to the laboratory. The Contractor shall be responsible for determining the specific disposal facilities to be utilized; and collect and analyze any samples required for disposal facility acceptance using a NELAP certified analytical laboratory registered with the State of Illinois.
The following areas should be monitored by the Environmental Firm for soil contamination and workers protection.

Site 3879-COV-1 – Jackie Joyner-Kersee Center MetroLink Station, 1009 N. 25th Street, East St. Louis, St. Clair County

- All excavation at Latitude 38.623565, Longitude -90.123363 associated with excavation for the 25th Street Pump Station cleanouts: The Engineer has determined this material meets the criteria of and shall be managed in accordance to Article 669.05(a)(1). Contaminants of concern sampling parameters: VOCs, SVOCs, and Metals.

Site 3879-COV-3 – Jones Park, 2950 Caseyville Avenue, East St. Louis, St. Clair County

- All excavation at Latitude 38.623522, Longitude -90.123005 associated with excavation for the 25th Street Pump Station cleanouts: The Engineer has determined this material meets the criteria of and shall be managed in accordance to Article 669.05(a)(5). Contaminants of concern sampling parameters: VOCs, SVOCs, and Metals.

Work Zones

Three distinct OSHA HAZWOPER work zones (exclusion, decontamination, and support) shall apply to projects adjacent to or within sites with documented leaking underground storage tank (LUST) incidents, or sites under management in accordance with the requirements of the Site Remediation Program (SRP), Resource Conservation and Recovery Act (RCRA), or Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), or as deemed necessary. For this project, the work zones apply for the following ISGS PESA Sites**:**
None

Additional information on the above sites collected during the Phase I Engineering process is available through the District's Environmental Studies Unit (DESU).
Any waste generated as a special waste or a waste not certified as a non-special waste from this project should be manifested off-site using the IEPA Bureau of Land generator number associated IDOT right-of-way in the affected county. **The IEPA generator number for IDOT right-of-way in St. Clair County is 1638995004.**

CONTAINMENT AND DISPOSAL OF LEAD PAINT CLEANING RESIDUES

Effective: October 2, 2001
Revised: April 22, 2016

Description. This work shall consist of the containment, collection, temporary storage, transportation and disposal of waste from lead paint removal projects. Waste requiring containment and control includes, but is not limited to, old paint, spent abrasives, corrosion products, mill scale, dirt, dust, grease, oil, salts, and water used for cleaning the surface of existing lead coatings prior to overcoating.

General. The existing coatings contain lead and may also contain other toxic metals. This specification provides the requirements for containment and for the protection of the public, and the environment from exposure to harmful levels of toxic metals that may be present in the paint being removed or repaired. The Contractor shall take reasonable and appropriate precautions to protect the public from the inhalation or ingestion of dust or debris from the operations, and is responsible for the clean-up of all spills of waste at no additional cost to the Department.

The Contractor shall comply with the requirements of this Specification and all applicable Federal, State, and Local laws, codes, and regulations, including, but not limited to the regulations of the United States Environmental Protection Agency (USEPA), Occupational Safety and Health Administration (OSHA), and Illinois Environmental Protection Agency (IEPA). The Contractor shall comply with all applicable regulations even if the regulation is not specifically referenced herein. If a Federal, State, or Local regulation is more restrictive than the requirements of this Specification, the more restrictive requirements shall prevail.

Submittals. The Contractor shall submit for Engineer review and acceptance, the following drawings and plans for accomplishing the work. The submittals shall be provided within 30 days of execution of the contract unless given written permission by the Engineer to submit them at a later date. Work cannot proceed until the submittals are accepted by the Engineer. Details for each of the plans are presented within the body of this specification. The Contractor shall also maintain on site, copies of the standards and regulations referenced herein (list provided in appendix 1).

a) Containment Plans. The containment plans shall include drawings, equipment specifications, and calculations (wind load, air flow and ventilation when negative pressure is specified. The plans shall include copies of the manufacturer's specifications for the containment materials and equipment that will be used to accomplish containment and ventilation.

   When required by the contract plans, the submittal shall provide calculations that assure the structural integrity of the bridge when it supports the containment and the calculations and drawings shall be signed and sealed by a Structural Engineer licensed in the state of Illinois.

   When working over the railroad or navigable waterways, the Department will notify the respective agencies that work is being planned. Unless otherwise noted in the plans, the Contractor is responsible for follow up contact with the agencies, and shall provide evidence that the railroad, Coast Guard, Corps of Engineers, and other applicable agencies are satisfied with the clearance provided and other safety measures that are proposed.

b) Environmental Monitoring Plan. The Environmental Monitoring Plan shall address the visual inspections and clean up of the soil and water that the Contractor will perform, including final project inspection and cleanup. The plan shall address the daily visible emissions observations that will be performed and the corrective action that will be implemented in the event emissions or releases occur. When high volume ambient air monitoring is required, an Ambient Air Monitoring Plan shall be developed. The plan shall include:

- Proposed monitor locations and power sources in writing. A site sketch shall be included, indicating sensitive receptors, monitor locations, and distances and directions from work area.
- Equipment specification sheet for monitors to be used, and a written commitment to calibrate and maintain the monitors.
- Include a procedure for operation of monitors per 40 CFR 50, Appendix B, including use of field data chain-of-custody form. Include a sample chain of custody form.
- Describe qualifications/training of monitor operator.
- The name, contact information (person's name and number), and certification of the laboratory performing the filter analysis. Laboratory shall be accredited by one of the following: 1) the American Industrial Hygiene Association (AIHA) for lead (metals) analysis, 2) Environmental Lead Laboratory Accreditation Program (ELLAP) for metals analysis, 3) State or federal accreditation program for ambient air analysis or, 4) the EPA National Lead Laboratory Accreditation Program (NLLAP) for lead analysis. The laboratory shall provide evidence of certification, a sample laboratory chain-of-custody form, and sample laboratory report that provides the information required by this specification. The laboratory shall also provide a letter committing to do the analysis per 40 CFR 50, Appendix G. If the analysis will not be performed per 40 CFR Appendix G, a proposed alternate method shall be described, together with the rationale for using it. The alternate method can not be used unless specifically accepted by the Engineer in writing.

c) Waste Management Plan. The Waste Management Plan shall address all aspects of handling, storage, testing, hauling and disposal of all project waste, including waste water. Include the names, addresses, and a contact person for the proposed licensed waste haulers and disposal facilities. Submit the name and qualifications of the laboratory proposed for Toxicity Characteristic Leaching Procedure (TCLP) analysis. If the use of abrasive additives is proposed, provide the name of the additive, the premixed ratio of additive to abrasive being provided by the supplier, and a letter from the supplier of the additive indicating IEPA acceptance of the material. Note that the use of any steel or iron based material, such as but not limited to grit, shot, fines, or filings as an abrasive additive is prohibited. The plan shall address weekly inspections of waste storage, maintaining an inspection log, and preparing a monthly waste accumulation inventory table.

d) Contingency Plan. The Contractor shall prepare a contingency plan for emergencies including fire, accident, failure of power, failure of dust collection system, failure of supplied air system or any other event that may require modification of standard operating procedures during lead removal. The plan shall include specific procedures to ensure safe egress and proper medical attention in the event of an emergency.

When the Engineer accepts the submittals, the Contractor will receive written notification. The Contractor shall not begin any work until the Engineer has accepted the submittals. The Contractor shall not construe Engineer acceptance of the submittals to imply approval of any particular method or sequence for conducting the work, or for addressing health and safety concerns. Acceptance of the plans does not relieve the Contractor from the responsibility to

conduct the work according to the requirements of Federal, State, or Local regulations, this specification, or to adequately protect the health and safety of all workers involved in the project and any members of the public who may be affected by the project. The Contractor remains solely responsible for the adequacy and completeness of the programs and work practices, and adherence to them.

Quality Control (QC) Inspections. The Contractor shall perform first line, in process QC inspections of all environmental control and waste handling aspects of the project to verify compliance with these specification requirements and the accepted drawings and plans. The Contractor shall use the IDOT Environmental Daily Report form to record the results of the inspections. Alternative forms (paper or electronic) will be allowed provided they furnish equivalent documentation as the IDOT form, and they are accepted as part of the QC Program submittal. The completed reports shall be turned into the Engineer before work resumes the following day. Contractor QC inspections shall include, but not be limited to the following:

- Proper installation and continued performance of the containment system(s) in accordance with the approved drawings.
- Visual inspections of emissions into the air and verification that the cause(s) for any unacceptable emissions is corrected.
- Set up, calibration, operation, and maintenance of the regulated area and high volume ambient air monitoring equipment, including proper shipment of cassettes/filters to the laboratory for analysis. Included is verification that the Engineer receives the results within the time frames specified and that appropriate steps are taken to correct work practices or containment in the event of unacceptable results.
- Visual inspections of spills or deposits of contaminated materials into the water or onto the ground, pavement, soil, or slope protection. Included is verification that proper cleanup is undertaken and that the cause(s) of unacceptable releases is corrected.
- Proper implementation of the waste management plan including laboratory analysis and providing the results to the Engineer within the time frames specified herein.
- Proper implementation of the contingency plans for emergencies.

The personnel providing the QC inspections shall poses current SSPC-C3 certification or equal, including the annual training necessary to maintain that certification (SSPC-C5 or equal), and shall provide evidence of successful completion of 2 bridge lead paint removal projects of similar or greater complexity and scope that have been completed in the last 2 years. References shall include the name, address, and telephone number of a contact person employed by the bridge owner. Proof of initial certification and the current annual training shall also be provided.

Quality Assurance (QA) Observations. The Engineer will conduct QA observations of any or all of the QC monitoring inspections that are undertaken. The presence or activity of Engineer observations in no way relieves the Contractor of the responsibility to provide all necessary daily QC inspections of its own and to comply with all requirements of this Specification.

Containment Requirements. The Contractor shall install and maintain containment systems surrounding the work for the purpose of controlling emissions of dust and debris according to the requirements of this specification. Working platforms and containment materials that are used shall be firm and stable and platforms shall be designed to support the workers, inspectors, spent surface preparation media (e.g., abrasives), and equipment during all phases of surface preparation and painting. Platforms, cables, and other supporting structures shall be designed according to OSHA regulations. If the containment needs to be attached to the structure, the

containment shall be attached by bolting, clamping, or similar means. Welding or drilling into the structure is prohibited unless approved by the Engineer in writing.

The containment shall be dropped in the event of sustained winds of 40 mph (64 kph) or greater and all materials and equipment secured.

The Contractor shall provide drawings showing the containment system and indicating the method(s) of supporting the working platforms and containment materials to each other and to the bridge. When the use of negative pressure and airflow inside containment is specified, the Contractor shall provide all ventilation calculations and details on the equipment that will be used for achieving the specified airflow and dust collection.

When directed in the contract plans, the Contractor shall submit calculations and drawings, signed and sealed by a Structural Engineer licensed in the state of Illinois, that assure the structural integrity of the bridge under the live and dead loads imposed, including the design wind loading.

When working over railroads, the Contractor shall provide evidence that the proposed clearance and the safety provisions that will be in place (e.g., flagman) are acceptable to the railroad. In the case of work over navigable waters, the Contractor shall provide evidence that the proposed clearance and provisions for installing or moving the containment out of navigation lanes is acceptable to authorities such as the Coast Guard and Army Corps of Engineers. The Contractor shall include plans for assuring that navigation lighting is not obscured, or if it is obscured, that temporary lighting is acceptable to the appropriate authorities (e.g., Coast Guard) and will be utilized.

Engineer review and acceptance of the drawings and calculations shall not relieve the Contractor from the responsibility for the safety of the working platforms and containment, and for providing ample ventilation to control worker and environmental exposures. After the work platforms and containment materials are erected additional measures may be needed to ensure worker safety according to OSHA regulations. The Contractor shall institute such measures at no additional cost to the Department.

Containment for the cleaning operation of this contract is defined as follows:

- The containment system shall maintain the work area free of visible emissions of dust and debris according to all provisions of this Specification, with no debris permitted outside of the regulated area at any time. All debris within the regulated area and within the containment shall be collected at the end of the last shift each day, and properly stored in sealed containers. Cleaning shall be accomplished by HEPA vacuuming unless it is conducted within a containment that is designed with a ventilation system capable of collecting the airborne dust and debris created by sweeping and blowing with compressed air. The ventilation system shall be in operation during the cleaning.

- The containment systems shall comply with the specified SSPC Guide 6 classifications as presented in Table 1 for the method of paint removal utilized.

- TSP-lead in the air at monitoring locations selected by the Contractor shall comply with the requirements specified herein.

The Contractor shall take appropriate action to avoid personnel injury or damage to the structure from the installation and use of the containment system. If the Engineer determines that there is

the potential for structural damage caused by the installed containment system, the Contractor shall take appropriate action to correct the situation.

In addition to complying with the specific containment requirements in Table 1 for each method of removal, the Contractor shall provide and maintain coverage over the ground in the areas to be cleaned. This coverage shall be capable of catching and containing surface preparation media, paint chips, and paint dust in the event of an accidental escape from the primary containment. The containment materials shall be cleaned of loose material prior to relocation or dismantling. Acceptable methods of cleaning include blowing down the surfaces with compressed air while the ventilation system is in operation, HEPA vacuuming, and/or wet wiping. If paint chips or dust is observed escaping from the containment materials during moving, all associated operations shall be halted and the materials and components recleaned.

The containment systems shall also meet the following requirements:

a) Dry Abrasive Blast Cleaning - Full Containment with Negative Pressure (SSPC Class 1A)

The enclosure shall be designed, installed, and maintained to sustain maximum anticipated wind forces, including negative pressure. Flapping edges of containment materials are prohibited and the integrity of all containment materials, seams, and seals shall be maintained for the duration of the project. Airflow inside containment shall be designed to provide visibility and reduce worker exposures to toxic metals according to OSHA regulations and as specified in Table 1 and its accompanying text. When the location of the work on the bridge, or over lane closures permit, the blast enclosure shall extend a minimum of 3 ft. (1 m) beyond the limits of surface preparation to allow the workers to blast away from, rather than into the seam between the containment and the structure. The blast enclosure shall have an airlock or resealable door entryway to allow entrance and exit from the enclosure without allowing the escape of blasting residue.

If recyclable metallic abrasives are used, the Contractor shall operate the equipment in a manner that minimizes waste generation. Steps shall also be taken to minimize dust generation during the transfer of all abrasive/paint debris (expendable or recyclable abrasives) for recycling or disposal. Acceptable methods include, but are not limited to vacuuming, screw or belt conveyance systems, or manual conveyance. However manual conveyance is only permitted if the work is performed inside a containment that is equipped with an operating ventilation system capable of controlling the dust that is generated.

Appropriate filtration shall be used on the exhaust air of dust collection and abrasive recycling equipment as required to comply with IEPA regulations. The equipment shall be cleaned/maintained, enclosed, or replaced if visible dust and debris are being emitted and/or the regulated area or high volume monitor lead levels are not in compliance.

Areas beneath containment connection points that were shielded from abrasive blast cleaning shall be prepared by vacuum blast cleaning or vacuum-shrouded power tool cleaning after the containment is removed.

b) Vacuum Blast Cleaning within Containment (SSPC-Class 4A)

Vacuum blasting equipment shall be fully automatic and capable of cleaning and recycling the abrasive. The system shall be designed to deliver cleaned, recycled blasting abrasives and

provide a closed system containment during blasting. The removed coating, mill scale, and corrosion shall be separated from the abrasive, and stored for disposal.

The Contractor shall attach containment materials around and under the work area to catch and contain abrasive and waste materials in the event of an accidental escape from the vacuum shroud. This containment is in addition to the ground covers specified earlier.

It is possible that the close proximity of some structural steel members, such as the end diaphragms or end cross-frames underneath transverse deck expansion joints, preclude the use of the vacuum blasting equipment for the removal of the old paint. For surfaces that are inaccessible for the nozzles of the vacuum blasting equipment, the Contractor shall remove the paint by means of full containment inside a complete enclosure as directed by the Engineer.

c) Vacuum-Shrouded Power Tool Cleaning within Containment (SSPC-Class 3P)

The Contractor shall utilize power tools equipped with vacuums and High Efficiency Particulate Air (HEPA) filters. The Contractor shall attach containment walls around the work area, and install containment materials beneath the work area to catch and contain waste materials in the event of an accidental escape from the vacuum shroud. This containment is in addition to the ground covers specified earlier and shall be installed within 10 ft. (3m) of the areas being cleaned.

d) Power Tool Cleaning without Vacuum, within Containment (SSPC-Class 2P)

When the use of power tools without vacuum attachments is authorized by the Engineer, the Contractor shall securely install containment walls and flooring around the work area to capture and collect all debris that is generated. The containment material requirements for this Class 2P are similar to Class 3P used for vacuum-shrouded tools, but the supporting structure will be more substantial in Class 2P to better secure the containment materials from excessive movement that could lead to the loss of waste paint chips and debris. Containment beneath the work shall be within 10 ft. (3m) of the areas being cleaned, and is in addition to the ground covers specified earlier.

e) Water Washing, Water Jetting or Wet Abrasive Blast Cleaning within Containment (SSPC Class 2W-3W)

Water washing of the bridge for the purpose of removing chalk, dirt, grease, oil, bird nests, and other surface debris, and water jetting or wet abrasive blast cleaning for the purpose of removing paint and surface debris shall be conducted within a containment designed, installed, and maintained in order to capture and contain all water and waste materials. The containment shall consist of impermeable floors and lower walls to prevent the water and debris from escaping. Permeable upper walls and ceilings are acceptable provided the paint chips, debris, and water, other than mists, are collected. A fine mist passing through the permeable upper walls is acceptable, provided the environmental controls specified below are met. If paint chips, debris, or water, other than mists, escape the containment system, impermeable walls and ceilings shall be installed.

When water is used for surface cleaning, the collected water shall be filtered to separate the particulate from the water. Recycling of the water is preferred in order to reduce the volume

of waste that is generated. The water after filtration shall be collected and disposed of according to the waste handling portions of this specification.

When a slurry is created by injecting water into the abrasive blast stream, the slurry need not be filtered to separate water from the particulate.

Environmental Controls and Monitoring. The Contractor shall prepare and submit to the Engineer for review and acceptance, an Environmental Monitoring Plan. The purpose of the plan is to address the observations and equipment monitoring undertaken by the Contractor to confirm that project dust and debris are not escaping the containment into the surrounding air, soil, and water.

a) Soil and Water. Containment systems shall be maintained to prevent the escape of paint chips, abrasives, and other debris into the water, and onto the ground, soil, slope protection, and pavements. Releases or spills of, paint chips, abrasives, dust and debris that have become deposited on surrounding property, structures, equipment or vehicles, and bodies of water are unacceptable. If there are inadvertent spills or releases, the Contractor shall immediately shut down the emissions-producing operations, clean up the debris, and change work practices, modify the containment, or take other appropriate corrective action as needed to prevent similar releases from occurring in the future.

   Water booms, boats with skimmers, or other means as necessary shall be used to capture and remove paint chips or project debris that falls or escapes into the water.

   At the end of each workday at a minimum, the work area inside and outside of containment, including ground tarpaulins, shall be inspected to verify that paint debris is not present. If debris is observed, it shall be removed by hand and HEPA-vacuuming. If wet methods of preparation are used, the damp debris can remain overnight provided it is protected from accidental release by securely covering the waste, folding the waste into the ground tarps, or by other acceptable methods. Prior to commencing work the next day, the debris from the folded ground tarps shall be removed.

   Upon project completion, the ground and water in and around the project site are considered to have been properly cleaned if paint chips, paint removal media (e.g., spent abrasives), fuel, materials of construction, litter, or other project debris have been removed.

   NOTE: All project debris must be removed even if the debris (e.g.,spent abrasive and paint chips) was a pre-existing condition.

b) Visible Emissions. The Contractor shall conduct observations of visible emissions and releases on an ongoing daily basis when dust-producing activities are underway, such as paint removal, clean up, waste handling, and containment dismantling or relocation. Note that visible emissions observations do not apply to the fine mist that may escape through permeable containment materials when wet methods of preparation are used.

   Visible emissions in excess of SSPC-TU7, Method A (Timing Method), Level 1 (1% of the workday) are unacceptable. In an 8-hour workday, this equates to emissions of a cumulative duration no greater than 5 minutes.. This criterion applies to scattered, random emissions of short duration. Sustained emissions from a given location (e.g., 1 minute or longer), regardless of the total length of emissions for the workday, are unacceptable and action shall be initiated to halt the emission.

If unacceptable visible emissions or releases are observed, the Contractor shall immediately shut down the emission-producing operations, clean up the debris, and change work practices, modify the containment, or take other appropriate corrective action as needed to prevent similar releases from occurring in the future.

c) Ambient Air Monitoring. The Contractor shall perform ambient air monitoring according to the following:

- Monitor Siting. The Contractor shall collect and analyze air samples to evaluate levels of TSP-lead if there are sensitive receptors within 5 times the height of the structure or within 1000 ft. (305 m) of the structure, whichever is greater. If sensitive receptors are not located within these limits, monitoring is not required. Sensitive receptors are areas of public presence or access including, but not limited to, homes, schools, parks, playgrounds, shopping areas, livestock areas, and businesses. The motoring public is not considered to be a sensitive receptor for the purpose of ambient air monitoring.

  The Contractor shall locate the monitors according to Section 7.3 of SSPC-TU-7, in areas of public exposure and in areas that will capture the maximum pollutant emissions resulting from the work. The Contractor shall identify the recommended monitoring sites in the Ambient Air Monitoring Plan, including a sketch identifying the above. The monitors shall not be sited until the Engineer accepts the proposed locations. When possible, monitors shall be placed at least 30 feet (9 m) away from highway traffic.

- Equipment Provided by Contractor. The Contractor shall provide up to 4 monitors per work site and all necessary calibration and support equipment, power to operate them, security (or arrangements to remove and replace the monitors daily), filters, flow chart recorders and overnight envelopes for shipping the filters to the laboratory. The number of monitors required will be indicated in the Plan Notes. Each monitor shall be tagged with the calibration date.

- Duration of Monitoring. Monitoring shall be performed for the duration of dust-producing operations (e.g., paint removal, waste handling, containment clean-up and movement, etc.) or a minimum of 8 hours each day (when work is performed).

  The monitoring schedule shall be as follows:

  1. For dry abrasive blast cleaning monitoring shall be conducted full time during all days of dust-producing operations (e.g., paint removal, waste handling, containment movement, etc.).
  2. For wet abrasive blast cleaning, water jetting, or power tool cleaning, monitoring shall be conducted for the first 5 days of dust producing operations. If the results after 5 days are acceptable, monitoring may be discontinued. If the results are unacceptable, corrective action shall be initiated to correct the cause of the emissions, and monitoring shall continue for an additional 5 days. If the results are still unacceptable, the Engineer may direct that the monitoring continue full time.

     When monitoring is discontinued, if visible emissions are observed and/or the Contractor's containment system changes during the course of the project, then air monitoring will again be required for a minimum of two consecutive days until compliance is shown.

- Background Monitoring. Background samples shall be collected for two days prior to the start of work while no dust producing operations are underway to provide a baseline. The background monitoring shall include one weekday and one weekend day. The background monitoring shall coincide with the anticipated working hours for the paint removal operations, but shall last for a minimum of 8 hours each day.

- Monitor Operation and Laboratory Analysis.

  The Contractor shall calibrate the monitors according to the manufacturer's written instructions upon mobilization to the site and quarterly. Each monitor shall be tagged with the calibration date, and calibration information shall be provided to the Engineer upon request.

  All ambient air monitoring shall be performed by the Contractor according to the accepted Ambient Air Monitoring Plan and according to EPA regulations 40 CFR Part 50 Appendix B, Reference Method for the Determination of Suspended Particulate Matter in the Atmosphere (High-Volume Method), and 40 CFR Part 50 Appendix G, Reference Method for the Determination of Lead in Suspended Particulate Matter Collected from Ambient Air.

  Filters shall be placed in monitors and monitors operated each day prior to start of dust-producing operations and the filters removed upon completion each day. The Contractor shall advise the Engineer in advance when the filters will be removed and replaced. The monitor operator shall record the following information, at a minimum, on field data and laboratory chain-of-custody forms (or equivalent):

  1. Monitor location and serial number
  2. Flow rate, supported by flow charts
  3. Start, stop times and duration of monitoring
  4. Work activities and location of work during the monitoring period
  5. Wind direction/speed

  For the first 5 days of monitoring, the Contractor shall submit the filters, field data and laboratory chain-of-custody forms together with the flow chart recorders (i.e. monitor flow rate and the duration of monitoring) on a daily basis in an overnight envelope to the laboratory for analysis. The laboratory must provide the Engineer with written results no later than 72 hours after the completion of each day's monitoring. At the discretion of the Engineer, if the initial 5 days of monitoring on full time monitoring projects is acceptable, the filters may be sent to the laboratory every 3 days rather than every day. Written results must be provided to the Engineer no later than 5 days after the completion of monitoring for the latest of the 3 days.

- Ambient Air Monitoring Results. The laboratory shall provide the report directly to the Engineer with a copy to the contractor. The report shall include:

  1. Monitor identification and location
  2. Work location and activities performed during monitoring period
  3. Monitor flow rate, duration, and volume of air sampled
  4. Laboratory methods used for filter digestion / analysis
  5. Sample results for the actual duration of monitoring

6. Sample results expressed in terms of a 24 hour time weighted average. Assume zero for period not monitored.
7. Comparison of the results with the acceptance criteria indicating whether the emissions are compliant.
8. Field data and chain-of-custody records used to derive results.

Should revised reports or any information regarding the analysis be issued by the laboratory directly to the Contractor at any time, the contractor shall immediately provide a copy to the Engineer and advise the laboratory that the Engineer is to receive all information directly from the laboratory.

- Acceptance Criteria. TSP-lead results at each monitor location shall be less than 1.5 μg/cu m per calendar quarter converted to a daily allowance using the formulas from SSPC- TU7 as follows, except that the maximum 24-hour daily allowance shall be no greater than 6 μg/cu m.

  The formula for determining a 24-hour daily value based on the actual number of paint disturbance days expected to occur during the 90-day quarter is:

  DA = (90 ÷ PD) x 1.5 μg/cu m, where

  DA is the daily allowance, and
  PD is the number of preparation days anticipated in the 90-day period
  If the DA calculation is > 6.0 μg/cu m, use 6.0 μg/cu m.

Regulated Areas. Physically demarcated regulated area(s) shall be established around exposure producing operations at the OSHA Action Level for the toxic metal(s) present in the coating. The Contractor shall provide all required protective clothing and personal protective equipment for personnel entering into a regulated area. Unprotected street clothing is not permitted within the regulated areas.

Hygiene Facilities/Protective Clothing/Blood Tests. The Contractor shall provide clean lavatory and hand washing facilities according to OSHA regulations and confirm that employees wash hands, forearms, and face before breaks. The facilities shall be located at the perimeter of the regulated area in close proximity to the paint removal operation. Shower facilities shall be provided when workers' exposures exceed the Permissible Exposure Limit. Showers shall be located at each bridge site, or if allowed by OSHA regulations, at a central location to service multiple bridges. The shower and wash facilities shall be cleaned at least daily during use.

All wash and shower water shall be filtered and containerized. The Contractor is responsible for filtration, testing, and disposal of the water.

The Contractor shall make available to all IDOT project personnel a base line and post project blood level screening for lead and zinc protoporphyrin (ZPP) (or the most current OSHA requirement) levels as determined by the whole blood lead method, utilizing the Vena-Puncture technique. This screening shall be made available every 2 months for the first 6 months, and every 6 months thereafter.

The Contractor shall provide IDOT project personnel with all required protective clothing and equipment, including disposal or cleaning. Clothing and equipment includes but is not limited to disposable coveralls with hood, booties, disposable surgical gloves, hearing protection, and safety glasses. The protective clothing and equipment shall be provided and maintained on the job site for the exclusive, continuous and simultaneous use by the IDOT personnel. This equipment shall be suitable to allow inspection access to any area in which work is being performed.

All handwash and shower facilities shall be fully available for use by IDOT project personnel.

Site Emergencies.

a) Stop Work. The Contractor shall stop work at any time the conditions are not within specifications and take the appropriate corrective action. The stoppage will continue until conditions have been corrected. Standby time and cost required for corrective action is at the Contractor's expense. The occurrence of the following events shall be reported in writing to IDOT and shall require the Contractor to automatically stop lead paint removal and initiate clean up activities.

- Airborne lead levels at any of the high volume ambient air monitoring locations that exceed the limits in this specification, or airborne lead in excess of the OSHA Action Level at the boundary of the regulated area.
- Break in containment barriers.
- Visible emissions in excess of the specification tolerances.
- Loss of negative air pressure when negative air pressure is specified (e.g., for dry abrasive blast cleaning).
- Serious injury within the containment area.
- Fire or safety emergency
- Respiratory system failure
- Power failure

b) Contingency Plans and Arrangements. The Engineer will refer to the contingency plan for site specific instructions in the case of emergencies.

The Contractor shall prepare a contingency plan for emergencies including fire, accident, failure of power, failure of dust collection system, failure of supplied air system or any other event that may require modification of standard operating procedures during lead removal. The plan shall include specific procedures to ensure safe egress and proper medical attention in the event of an emergency. The Contractor shall post the telephone numbers and locations of emergency services including fire, ambulance, doctor, hospital, police, power company and telephone company on clean side of personnel decontamination area.

A two-way radio, or equal, as approved by the Engineer, capable of summoning emergency assistance shall be available at each bridge during the time the Contractor's personnel are at the bridge site under this contract. The following emergency response equipment described in the contingency plan (generic form attached) shall be available during this time as well: an appropriate portable fire extinguisher, a 55 gal (208 L) drum, a 5 gal (19 L) pail, a long handled shovel, absorbent material (one bag).

A copy of the contingency plan shall be maintained at each bridge during cleaning operations and during the time the Contractor's personnel are at the bridge site under this contract. The

Contractor shall designate the emergency coordinator(s) required who shall be responsible for the activities described.

An example of a contingency plan is included at the end of this Special Provision.

Collection, Temporary Storage, Transportation and Disposal of Waste. The Contractor and the Department are considered to be co-generators of the waste.

The Contractor is responsible for all aspects of waste collection, testing and identification, handling, storage, transportation, and disposal according to these specifications and all applicable Federal, State, and Local regulations. The Contractor shall provide for Engineer review and acceptance a Waste Management Plan that addresses all aspects of waste handling, storage, and testing, and provides the names, addresses, and a contact person for the proposed licensed waste haulers and disposal facilities. The Department will not perform any functions relating to the waste other than provide EPA identification numbers, provide the Contractor with the emergency response information, the emergency response telephone number required to be provided on the manifest, and to sign the waste manifest. The Engineer will obtain the identification numbers from the state and federal environmental protection agencies for the bridge(s) to be painted and furnish those to the Contractor.

All surface preparation/paint residues shall be collected daily and deposited in all-weather containers supplied by the Contractor as temporary storage. The storage area shall be secure to prevent unauthorized entry or tampering with the containers. Acceptable measures include storage within a fully enclosed (e.g., fenced in) and locked area, within a temporary building, or implementing other reasonable means to reduce the possibility of vandalism or exposure of the waste to the public or the environment (e.g., securing the lids or covers of waste containers and roll-off boxes). Waste shall not be stored outside of the containers. Waste shall be collected and transferred to bulk containers taking extra precautions as necessary to prevent the suspension of residues in air or contamination of surrounding surfaces. Precautions may include the transfer of the material within a tarpaulin enclosure. Transfer into roll-off boxes shall be planned to minimize the need for workers to enter the roll-off box.

No residues shall remain on surfaces overnight, either inside or outside of containment. Waste materials shall not be removed through floor drains or by throwing them over the side of the bridge. Flammable materials shall not be stored around or under any bridge structures.

The all-weather containers shall meet the requirements for the transportation of hazardous materials and as approved by the Department. Acceptable containers include covered roll-off boxes and 55-gallon drums (17H). The Contractor shall insure that no breaks and no deterioration of these containers occurs and shall maintain a written log of weekly inspections of the condition of the containers. A copy of the log shall be furnished to the Engineer upon request. The containers shall be kept closed and sealed from moisture except during the addition of waste. Each container shall be permanently identified with the date that waste was placed into the container, contract number, hazardous waste name and ID number, and other information required by the IEPA.

The Contractor shall have each waste stream sampled for each project and tested by TCLP and according to EPA and disposal company requirements. The Engineer shall be notified in advance when the samples will be collected. The samples shall be collected and shipped for testing within the first week of the project, with the results due back to the Engineer within 10 days. Testing

shall be considered included in the pay item for "Containment and Disposal of Lead Paint Cleaning Residues." Copies of the test results shall be provided to the Engineer prior to shipping the waste.

Waste water generated from bridge washing, hygiene purposes, and cleaning of equipment shall be filtered on site to remove particulate and disposed of at a Publicly Owned Treatment Works (POTW) according to State regulations. The Contractor shall provide the Engineer with a letter from the POTW indicating that they will accept the waste water. If the POTW allows the filtered water to be placed into the sanitary sewer system, the Contractor shall provide a letter from the POTW indicating that based on the test results of the water, disposal in the sanitary sewer is acceptable to them. Water shall not be disposed of until the above letter(s) are provided to, and accepted by, the Engineer.

If approved abrasive additives are used that render the waste non-hazardous as determined by TCLP testing, the waste shall be classified as a non-hazardous special waste, transported by a licensed waste transporter, and disposed of at an IEPA permitted disposal facility in Illinois.

When paint is removed from the bridge without the use of abrasive additives, the paint, together with the surface preparation media (e.g. abrasive) shall be handled as a hazardous waste, regardless of the TCLP results. The waste shall be transported by a licensed hazardous waste transporter, treated by an IEPA permitted treatment facility to a non-hazardous special waste and disposed of at an IEPA permitted disposal facility in Illinois.

The treatment/disposal facilities shall be approved by the Engineer, and shall hold an IEPA permit for waste disposal and waste stream authorization for this cleaning residue. The IEPA permit and waste stream authorization must be obtained prior to beginning cleaning, except that if necessary, limited paint removal will be permitted in order to obtain samples of the waste for the disposal facilities. The waste shall be shipped to the facility within 90 days of the first accumulation of the waste in the containers. When permitted by the Engineer, waste from multiple bridges in the same contract may be transported by the Contractor to a central waste storage location(s) approved by the Engineer in order to consolidate the material for pick up, and to minimize the storage of waste containers at multiple remote sites after demobilization. Arrangements for the final waste pickup shall be made with the waste hauler by the time blast cleaning operations are completed or as required to meet the 90 day limit stated above.

The Contractor shall submit a waste accumulation inventory table to the Engineer no later than the 5th day of the month. The table shall show the number and size of waste containers filled each day in the preceding month and the amount of waste shipped that month, including the dates of shipments.

The Contractor shall prepare a manifest supplied by the IEPA for off-site treatment and disposal before transporting the hazardous waste off-site. The Contractor shall prepare a land ban notification for the waste to be furnished to the disposal facility. The Contractor shall obtain the handwritten signature of the initial transporter and date of the acceptance of the manifest. The Contractor shall send one copy of the manifest to the IEPA within two working days of transporting the waste off-site. The Contractor shall furnish the generator copy of the manifest and a copy of the land ban notification to the Engineer. The Contractor shall give the transporter the remaining copies of the manifest.

All other project waste shall be removed from the site according to Federal, State and Local regulations, with all waste removed from the site prior to final Contractor demobilization.

The Contractor shall make arrangements to have other hazardous waste, which he/she generates, such as used paint solvent, transported to the Contractor's facility at the end of each day that this waste is generated. These hazardous wastes shall be manifested using the Contractor's own generator number to a treatment or disposal facility from the Contractor's facility. The Contractor shall not combine solvents or other wastes with cleaning residue wastes. All waste streams shall be stored in separate containers.

The Contractor is responsible for the payment of any fines and undertaking any clean up activities mandated by State or federal environmental agencies for improper waste handling, storage, transportation, or disposal.

Contractor personnel shall be trained in the proper handling of hazardous waste, and the necessary notification and clean up requirements in the event of a spill. The Contractor shall maintain a copy of the personnel training records at each bridge site.

Basis of Payment. The soil, water, and air monitoring, containment, collection, temporary storage, transportation, testing and disposal of all project waste, and all other work described herein will be paid for at the contract lump sum price for CONTAINMENT AND DISPOSAL OF LEAD PAINT CLEANING RESIDUES at the designated location. Payment will not be authorized until all requirements have been fulfilled as described in this specification, including the preparation and submittal of all QC documentation, submittal of environmental monitoring and waste test results, and disposal of all waste.

Appendix 1 – Reference List

The Contractor shall maintain the following reference standards and regulations on site for the duration of the project:

- Illinois Environmental Protection Agency – Information Statement on the Removal of Lead-Based Paint from Exterior Surfaces, latest revision
- Illinois Environmental Protection Act
- SSPC Guide 6, Guide for Containing Debris Generated During Paint Removal Operations
- 29 CFR 1926.62, Lead in Construction
- 40 CFR Part 50, Appendix B, Reference Method for the Determination of Suspended Particulate Matter in the Atmosphere (High-Volume Method)
- 40 CFR Part 50, Appendix G, Reference Method for the Determination of Lead in Suspended Particulate Matter Collected from Ambient Air
- SSPC Guide 16, Guide to Specifying and Selecting Dust Collectors
- SSPC TU-7, Conducting Ambient Air, Soil, and Water Sampling Activities During Surface Preparation and Paint Disturbance Activities.

Table 1
Containment Criteria for Removal of Paint Containing Lead and Other Toxic Metals[1]

Removal Method	SSPC Class[2]	Containment Material Flexibility	Containment Material Permeability[3]	Containment Support Structure	Containment Material Joints[4]
Hand Tool Cleaning	3P[6]	Rigid or Flexible	Permeable or Impermeable	Minimal	Partially Sealed
Power Tool Cleaning w/ Vacuum	3P[6]	Rigid or Flexible	Permeable or Impermeable	Minimal	Partially Sealed
Power Tool Cleaning w/o Vacuum	2P	Rigid or Flexible	Permeable or Impermeable	Rigid or Flexible	Fully or Partially Sealed
Water Jetting Wet Ab Blast Water Cleaning[7]	2W-3W	Rigid or Flexible	Permeable and Impermeable[7]	Rigid, Flexible, or Minimal	Fully and Partially Sealed
Abrasive Blast Cleaning	1A	Rigid or Flexible	Impermeable	Rigid or Flexible	Fully Sealed
Vacuum Blast Cleaning	4A[6]	Rigid or Flexible	Permeable	Minimal	Partially Sealed

Table 1 (Continued)
Containment Criteria for Removal of Paint Containing Lead and Other Toxic Metals[1]

Removal Method	SSPC Class[2]	Containment Entryway	Ventilation System Required[5]	Negative Pressure Required	Exhaust Filtration Required
Hand Tool Cleaning	3P[6]	Overlapping or Open Seam	Natural	No	No
Power Tool Cleaning w/ Vacuum	3P[6]	Overlapping or Open Seam	Natural	No	No
Power Tool Cleaning w/o Vacuum	2P	Overlapping or Open Seam	Natural	No	No
Water Jetting Wet Ab Blast Water Cleaning[7]	2W-3W	Overlapping or Open Seam	Natural	No	No
Abrasive Blast Cleaning	1A	Airlock or Resealable	Mechanical	Yes	Yes
Vacuum Blast Cleaning	4A[6]	Open Seam	Natural	No	No

Notes:

[1]This table provides general design criteria only. It does not guarantee that specific controls over emissions will occur because unique site conditions must be considered in the design. Other combinations of materials may provide controls over emissions equivalent to or greater than those combinations shown above.

[2]The SSPC Classification is based on SSPC Guide 6. Note that for work over water, water booms or boats with skimmers must be employed, where feasible, to contain spills or releases. Debris must be removed daily at a minimum.

[3]Permeability addresses both air and water as appropriate. In the case of water removal methods, the containment materials must be resistant to water. Ground covers should always impermeable, and of sufficient strength to withstand the impact and weight of the debris and the equipment used for collection and clean-up. Ground covers must also extend beyond the containment boundary to capture escaping debris.

[4] If debris escapes through the seams, then additional sealing of the seams and joints is required.

[5]When “Natural” is listed, ventilation is not required provided the emissions are controlled as specified in this Special Provision, and provided worker exposures are properly controlled. If unacceptable emissions or worker exposures to lead or other toxic metals occur, incorporate a ventilation system into the containment.

[6]Ground covers and wall tarpaulins may provide suitable controls over emissions without the need to completely enclose the work area.

[7]This method applies to water cleaning to remove surface contaminants, and water jetting (with and without abrasive) and wet abrasive blast cleaning where the goal is to remove paint. Although both permeable and impermeable containment materials are included, ground covers and the lower portions of the containment must be water impermeable with fully sealed joints, and of sufficient strength and integrity to facilitate the collection and holding of the water and debris for proper disposal. If water or debris, other than mist, escape through upper sidewalls or ceiling areas constructed of permeable materials, they shall be replaced with impermeable materials. Permeable materials for the purpose of this specification are defined as materials with openings measuring 25 mils (1 micron) or less in greatest dimension.

A. Containment Components - The basic components that make up containment systems are defined below. The components are combined in Table 1 to establish the minimum containment system requirements for the method(s) of paint removal specified for the Contract.

1. Rigidity of Containment Materials - Rigid containment materials consist of solid panels of plywood, aluminum, rigid metal, plastic, fiberglass, composites, or similar materials. Flexible materials consist of screens, tarps, drapes, plastic sheeting, or similar materials. When directed by the Engineer, do not use flexible materials for horizontal surfaces directly over traffic lanes or vertical surfaces in close proximity to traffic lanes. If the Engineer allows the use of flexible materials, The Contractor shall take special precautions to completely secure the materials to prevent any interference with traffic.

2. Permeability of Containment Materials - The containment materials are identified as air impenetrable if they are impervious to dust or wind such as provided by rigid panels, coated solid tarps, or plastic sheeting. Air penetrable materials are those that are formed or woven to allow air flow. Water impermeable materials are those that are capable of containing and controlling water when wet methods of preparation are used. Water permeable materials allow the water to pass through. Chemical resistant materials are those resistant to chemical and solvent stripping solutions. Use fire retardant materials in all cases.

3. Support Structure - Rigid support structures consist of scaffolding and framing to which the containment materials are affixed to minimize movement of the containment cocoon. Flexible support structures are comprised of cables, chains, or similar systems to which the containment materials are affixed. Use fire retardant materials in all cases.

4. Containment Joints - Fully sealed joints require that mating surfaces between the containment materials and to the structure being prepared are completely sealed. Sealing measures include tape, caulk, Velcro, clamps, or other similar material capable of forming a continuous, impenetrable or impermeable seal. When materials are overlapped, a minimum overlap of 8 in. (200 mm) is required.

5. Entryway - An airlock entryway involves a minimum of one stage that is fully sealed to the containment and which is maintained under negative pressure using the ventilation system of the containment. Resealable door entryways involve the use of flexible or rigid doors capable of being repeatedly opened and resealed. Sealing methods include the use of zippers, Velcro, clamps, or similar fasteners. Overlapping door tarpaulin entryways consist of two or three overlapping door tarpaulins.

6. Mechanical Ventilation - The requirement for mechanical ventilation is to ensure that adequate air movement is achieved to reduce worker exposure to toxic metals to as low as feasible according to OSHA regulations (e.g., 29 CFR 1926.62), and to enhance visibility. Design the system with proper exhaust ports or plenums, adequately sized ductwork, adequately sized

discharge fans and air cleaning devices (dust collectors) and properly sized and distributed make-up air points to achieve a uniform air flow inside containment for visibility. The design target for airflow shall be a minimum of 100 ft. (30.5m) per minute cross-draft or 60 ft. (18.3 m) per minute downdraft. Increase these minimum airflow requirements if necessary to address worker lead exposures. Natural ventilation does not require the use of mechanical equipment for moving dust and debris through the work area.

7. Negative Pressure - When specified, achieve a minimum of 0.03 in. (7.5 mm) water column (W.C.) relative to ambient conditions, or confirm through visual assessments for the concave appearance of the containment enclosure.

8. Exhaust Ventilation - When mechanical ventilation systems are used, provide filtration of the exhaust air, to achieve a filtration efficiency of 99.9 percent at 0.02 mils (0.5 microns).

HAZARDOUS WASTE CONTINGENCY PLAN FOR LEAD BASED PAINT REMOVAL PROJECTS

Bridge No.: _____
Location: _____
USEPA Generator No.: _____
IEPA Generator No.: _____

Note:

1. A copy of this plan must be kept at the bridge while the Contractor's employees are at the site.

2. A copy of the plan must be mailed to the police and fire departments and hospital identified herein.

Primary Emergency Coordinator

Name: _____
Address: _____
City: _____
Phone: (Work) _____
(Home) _____

Alternate Emergency Coordinator

Name: _____
Address: _____
City: _____
Phone: (Work) _____
(Home) _____

Emergency Response Agencies

POLICE:

1. State Police (if bridge not in city) Phone:_____

   District No. _____

   Address: _____

2. County Sheriff _____Phone: _____

   County: _____

   Address: _____

3. City Police _____Phone: _____

   District No. _____

   Address: _____

Arrangements made with police: (Describe arrangements or refusal by police to make arrangements):

_____

_____

FIRE:

1. City _____ Phone: _____

   Name: _____

   Address: _____

2. Fire District _____ Phone: _____

   Name: _____

   Address: _____

3. Other _____ Phone: _____

   Name: _____

   Address: _____

Arrangements made with fire departments: (Describe arrangements or refusal by fire departments to make arrangements):

_____

_____

HOSPITAL:

Name: _____ Phone: _____

Address: _____

Arrangements made with hospital: (Describe arrangements or refusal by hospital to make arrangements):

_____

_____

Properties of waste and hazard to health:

Places where employees working:

Location of Bridge:

Types of injuries or illness which could result:

Appropriate response to release of waste to the soil:

Appropriate response to release of waste to surface water:

Emergency Equipment at Bridge

Emergency Equipment List	Location of Equipment	Description of Equipment	Capability of Equipment
1. Two-way radio	Truck		Communication
2. Portable Fire Extinguisher	Truck		Extinguishes Fire
3. Absorbent Material	Truck		Absorbs Paint or Solvent Spills
4. Hand Shovel	Truck		Scooping Material
5. 55 Gallon (208 L) Drum	Truck		Storing Spilled Material
6. 5 Gallon (19 L) Pail	Truck		Storing Spilled Material

Emergency Procedure

1. Notify personnel at the bridge of the emergency and implement emergency procedure.

2. Identify the character, source, amount and extent of released materials.

3. Assess possible hazards to health or environment.

4. Contain the released waste or extinguish fire. Contact the fire department if appropriate.

5. If human health or the environment is threatened, contact appropriate police and fire department. In addition, the Emergency Services and Disaster Agency needs to be called using their 24-hour toll free number (800-782-7860) and the National Response Center using their 24-hour toll free number (800-824-8802).

6. Notify the Engineer that an emergency has occurred.

7. Store spilled material and soil contaminated by spill, if any, in a drum or pail. Mark and label the drum or pail for disposal.

8. Write a full account of the spill or fire incident including date, time, volume, material, and response taken.

9. Replenish stock of absorbent material or other equipment used in response.

BLENDED FINELY DIVIDED MINERALS (BDE)

Effective: April 1, 2021

Revise the second paragraph of Article 1010.01 of the Standard Specifications to read:

"Different sources or types of finely divided minerals shall not be mixed or used alternately in the same item of construction, except as a blended finely divided mineral product according to Article 1010.06."

Add the following article to Section 1010 of the Standard Specifications:

"**1010.06 Blended Finely Divided Minerals.** Blended finely divided minerals shall be the product resulting from the blending or intergrinding of two or three finely divided minerals. Blended finely divided minerals shall be according to ASTM C 1697, except as follows.

(a) Blending shall be accomplished by mechanically or pneumatically intermixing the constituent finely divided minerals into a uniform mixture that is then discharged into a silo for storage or tanker for transportation.

(b) The blended finely divided mineral product will be classified according to its predominant constituent or the manufacturer's designation and shall meet the chemical requirements of its classification. The other finely divided mineral constituent(s) will not be required to conform to their individual standards."

COMPENSABLE DELAY COSTS (BDE)

Effective: June 2, 2017 Revised: April 1, 2019

Revise Article 107.40(b) of the Standard Specifications to read:

"(b) Compensation. Compensation will not be allowed for delays, inconveniences, or damages sustained by the Contractor from conflicts with facilities not meeting the above definition; or if a conflict with a utility in an unanticipated location does not cause a shutdown of the work or a documentable reduction in the rate of progress exceeding the limits set herein. The provisions of Article 104.03 notwithstanding, compensation for delays caused by a utility in an unanticipated location will be paid according to the provisions of this Article governing minor and major delays or reduced rate of production which are defined as follows.

(1) Minor Delay. A minor delay occurs when the work in conflict with the utility in an unanticipated location is completely stopped for more than two hours, but not to exceed two weeks.

(2) Major Delay. A major delay occurs when the work in conflict with the utility in an unanticipated location is completely stopped for more than two weeks.

(3) Reduced Rate of Production Delay. A reduced rate of production delay occurs when the rate of production on the work in conflict with the utility in an unanticipated location decreases by more than 25 percent and lasts longer than seven calendar days."

Revise Article 107.40(c) of the Standard Specifications to read:

"(c) Payment. Payment for Minor, Major, and Reduced Rate of Production Delays will be made as follows.

(1) Minor Delay. Labor idled which cannot be used on other work will be paid for according to Article 109.04(b)(1) and (2) for the time between start of the delay and the minimum remaining hours in the work shift required by the prevailing practice in the area.

Equipment idled which cannot be used on other work, and which is authorized to standby on the project site by the Engineer, will be paid for according to Article 109.04(b)(4).

(2) Major Delay. Labor will be the same as for a minor delay.

Equipment will be the same as for a minor delay, except Contractor-owned equipment will be limited to two weeks plus the cost of move-out to either the Contractor's yard or another job and the cost to re-mobilize, whichever is less. Rental equipment may be paid for longer than two weeks provided the Contractor presents adequate support to the Department (including lease agreement) to show retaining equipment on the job is the most economical course to follow and in the public interest.

(3) Reduced Rate of Production Delay. The Contractor will be compensated for the reduced productivity for labor and equipment time in excess of the 25 percent threshold for that portion of the delay in excess of seven calendar days. Determination of compensation will be in accordance with Article 104.02, except labor and material additives will not be permitted.

Payment for escalated material costs, escalated labor costs, extended project overhead, and extended traffic control will be determined according to Article 109.13."

Revise Article 108.04(b) of the Standard Specifications to read:

"(b) No working day will be charged under the following conditions.

(1) When adverse weather prevents work on the controlling item.

(2) When job conditions due to recent weather prevent work on the controlling item.

(3) When conduct or lack of conduct by the Department or its consultants, representatives, officers, agents, or employees; delay by the Department in making the site available; or delay in furnishing any items required to be furnished to the Contractor by the Department prevents work on the controlling item.

(4) When delays caused by utility or railroad adjustments prevent work on the controlling item.

(5) When strikes, lock-outs, extraordinary delays in transportation, or inability to procure critical materials prevent work on the controlling item, as long as these delays are not due to any fault of the Contractor.

(6) When any condition over which the Contractor has no control prevents work on the controlling item."

Revise Article 109.09(f) of the Standard Specifications to read:

"(f) Basis of Payment. After resolution of a claim in favor of the Contractor, any adjustment in time required for the work will be made according to Section 108. Any adjustment in the costs to be paid will be made for direct labor, direct materials, direct equipment, direct jobsite overhead, direct offsite overhead, and other direct costs allowed by the resolution. Adjustments in costs will not be made for interest charges, loss of anticipated profit, undocumented loss of efficiency, home office overhead and unabsorbed overhead other than as allowed by Article 109.13, lost opportunity, preparation of claim expenses and other consequential indirect costs regardless of method of calculation.

The above Basis of Payment is an essential element of the contract and the claim cost recovery of the Contractor shall be so limited."

Add the following to Section 109 of the Standard Specifications.

"**109.13 Payment for Contract Delay.** Compensation for escalated material costs, escalated labor costs, extended project overhead, and extended traffic control will be allowed when such costs result from a delay meeting the criteria in the following table.

Contract Type	Cause of Delay	Length of Delay
Working Days	Article 108.04(b)(3) or Article 108.04(b)(4)	No working days have been charged for two consecutive weeks.
Completion Date	Article 108.08(b)(1) or Article 108.08(b)(7)	The Contractor has been granted a minimum two week extension of contract time, according to Article 108.08.

Payment for each of the various costs will be according to the following.

(a) Escalated Material and/or Labor Costs. When the delay causes work, which would have otherwise been completed, to be done after material and/or labor costs have increased, such increases will be paid. Payment for escalated material costs will be limited to the increased costs substantiated by documentation furnished by the Contractor. Payment for escalated labor costs will be limited to those items in Article 109.04(b)(1) and (2), except the 35 percent and 10 percent additives will not be permitted.

(b) Extended Project Overhead. For the duration of the delay, payment for extended project overhead will be paid as follows.

(1) Direct Jobsite and Offsite Overhead. Payment for documented direct jobsite overhead and documented direct offsite overhead, including onsite supervisory and administrative personnel, will be allowed according to the following table.

Original Contract Amount	Supervisory and Administrative Personnel
Up to $5,000,000	One Project Superintendent
Over $ 5,000,000 - up to $25,000,000	One Project Manager, One Project Superintendent or Engineer, and One Clerk
Over $25,000,000 - up to $50,000,000	One Project Manager, One Project Superintendent, One Engineer, and One Clerk
Over $50,000,000	One Project Manager, Two Project Superintendents, One Engineer, and One Clerk

(2) Home Office and Unabsorbed Overhead. Payment for home office and unabsorbed overhead will be calculated as 8 percent of the total delay cost.

(c) Extended Traffic Control. Traffic control required for an extended period of time due to the delay will be paid for according to Article 109.04.

When an extended traffic control adjustment is paid under this provision, an adjusted unit price as provided for in Article 701.20(a) for increase or decrease in the value of work by more than ten percent will not be paid.

Upon payment for a contract delay under this provision, the Contractor shall assign subrogation rights to the Department for the Department's efforts of recovery from any other party for monies paid by the Department as a result of any claim under this provision. The Contractor shall fully cooperate with the Department in its efforts to recover from another party any money paid to the Contractor for delay damages under this provision."

CONSTRUCTION AIR QUALITY – DIESEL RETROFIT (BDE)

Effective: June 1, 2010 Revised: November 1, 2014

The reduction of emissions of particulate matter (PM) for off-road equipment shall be accomplished by installing retrofit emission control devices. The term "equipment" refers to diesel fuel powered devices rated at 50 hp and above, to be used on the jobsite in excess of seven calendar days over the course of the construction period on the jobsite (including rental equipment).

Contractor and subcontractor diesel powered off-road equipment assigned to the contract shall be retrofitted using the phased in approach shown below. Equipment that is of a model year older than the year given for that equipment's respective horsepower range shall be retrofitted:

Effective Dates	Horsepower Range	Model Year
June 1, 2010 1/	600-749	2002
	750 and up	2006
June 1, 2011 2/	100-299	2003
	300-599	2001
	600-749	2002
	750 and up	2006
June 1, 2012 2/	50-99	2004
	100-299	2003
	300-599	2001
	600-749	2002
	750 and up	2006

1/ Effective dates apply to Contractor diesel powered off-road equipment assigned to the contract.

2/ Effective dates apply to Contractor and subcontractor diesel powered off-road equipment assigned to the contract.

The retrofit emission control devices shall achieve a minimum PM emission reduction of 50 percent and shall be:

a) Included on the U.S. Environmental Protection Agency (USEPA) *Verified Retrofit Technology List* (http://www.epa.gov/cleandiesel/verification/verif-list.htm), or verified by the California Air Resources Board (CARB) (http://www.arb.ca.gov/diesel/verdev/vt/cvt.htm); or

b) Retrofitted with a non-verified diesel retrofit emission control device if verified retrofit emission control devices are not available for equipment proposed to be used on the project, and if the Contractor has obtained a performance certification from the retrofit device manufacturer that the emission control device provides a minimum PM emission reduction of 50 percent.

Note: Large cranes (Crawler mounted cranes) which are responsible for critical lift operations are exempt from installing retrofit emission control devices if such devices adversely affect equipment operation.

Diesel powered off-road equipment with engine ratings of 50 hp and above, which are unable to be retrofitted with verified emission control devices or if performance certifications are not available which will achieve a minimum 50 percent PM reduction, may be granted a waiver by the Department if documentation is provided showing good faith efforts were made by the Contractor to retrofit the equipment.

Construction shall not proceed until the Contractor submits a certified list of the diesel powered off-road equipment that will be used, and as necessary, retrofitted with emission control devices. The list(s) shall include (1) the equipment number, type, make, Contractor/rental company name; and (2) the emission control devices make, model, USEPA or CARB verification number, or performance certification from the retrofit device manufacturer. Equipment reported as fitted with emissions control devices shall be made available to the Engineer for visual inspection of the device installation, prior to being used on the jobsite.

The Contractor shall submit an updated list of retrofitted off-road construction equipment as retrofitted equipment changes or comes on to the jobsite. The addition or deletion of any diesel powered equipment shall be included on the updated list.

If any diesel powered off-road equipment is found to be in non-compliance with any portion of this special provision, the Engineer will issue the Contractor a diesel retrofit deficiency deduction.

Any costs associated with retrofitting any diesel powered off-road equipment with emission control devices shall be considered as included in the contract unit prices bid for the various items of work involved and no additional compensation will be allowed. The Contractor's compliance with this notice and any associated regulations shall not be grounds for a claim.

Diesel Retrofit Deficiency Deduction

When the Engineer determines that a diesel retrofit deficiency exists, a daily monetary deduction will be imposed for each calendar day or fraction thereof the deficiency continues to exist. The calendar day(s) will begin when the time period for correction is exceeded and end with the Engineer's written acceptance of the correction. The daily monetary deduction will be $1,000.00 for each deficiency identified.

The deficiency will be based on lack of diesel retrofit emissions control.

If a Contractor accumulates three diesel retrofit deficiency deductions for the same piece of equipment in a contract period, the Contractor will be shutdown until the deficiency is corrected. Such a shutdown will not be grounds for any extension of the contract time, waiver of penalties, or be grounds for any claim.

DISADVANTAGED BUSINESS ENTERPRISE PARTICIPATION (BDE)

Effective: September 1, 2000 Revised: March 2, 2019

FEDERAL OBLIGATION. The Department of Transportation, as a recipient of federal financial assistance, is required to take all necessary and reasonable steps to ensure nondiscrimination in the award and administration of contracts. Consequently, the federal regulatory provisions of 49 CFR Part 26 apply to this contract concerning the utilization of disadvantaged business enterprises. For the purposes of this Special Provision, a disadvantaged business enterprise (DBE) means a business certified by the Department in accordance with the requirements of 49 CFR Part 26 and listed in the Illinois Unified Certification Program (IL UCP) DBE Directory.

STATE OBLIGATION. This Special Provision will also be used by the Department to satisfy the requirements of the Business Enterprise for Minorities, Females, and Persons with Disabilities Act, 30 ILCS 575. When this Special Provision is used to satisfy state law requirements on 100 percent state-funded contracts, the federal government has no involvement in such contracts (not a federal-aid contract) and no responsibility to oversee the implementation of this Special Provision by the Department on those contracts. DBE participation on 100 percent state-funded contracts will not be credited toward fulfilling the Department's annual overall DBE goal required by the US Department of Transportation to comply with the federal DBE program requirements.

CONTRACTOR ASSURANCE. The Contractor makes the following assurance and agrees to include the assurance in each subcontract the Contractor signs with a subcontractor.

> The Contractor, subrecipient, or subcontractor shall not discriminate on the basis of race, color, national origin, or sex in the performance of this contract. The Contractor shall carry out applicable requirements of 49 CFR Part 26 in the award and administration of contracts funded in whole or in part with federal or state funds. Failure by the Contractor to carry out these requirements is a material breach of this contract, which may result in the termination of this contract or such other remedy as the recipient deems appropriate, which may include, but is not limited to:
>
> (a) Withholding progress payments;
>
> (b) Assessing sanctions;
>
> (c) Liquidated damages; and/or
>
> (d) Disqualifying the Contractor from future bidding as non-responsible.

OVERALL GOAL SET FOR THE DEPARTMENT. As a requirement of compliance with 49 CFR Part 26, the Department has set an overall goal for DBE participation in its federally assisted contracts. That goal applies to all federal-aid funds the Department will expend in its federally assisted contracts for the subject reporting fiscal year. The Department is required to make a good faith effort to achieve the overall goal. The dollar amount paid to all approved DBE companies performing work called for in this contract is eligible to be credited toward fulfillment of the Department's overall goal.

CONTRACT GOAL TO BE ACHIEVED BY THE CONTRACTOR. This contract includes a specific DBE utilization goal established by the Department. The goal has been included because

the Department has determined the work of this contract has subcontracting opportunities that may be suitable for performance by DBE companies. The determination is based on an assessment of the type of work, the location of the work, and the availability of DBE companies to do a part of the work. The assessment indicates, in the absence of unlawful discrimination and in an arena of fair and open competition, DBE companies can be expected to perform **2.00%** of the work. This percentage is set as the DBE participation goal for this contract. Consequently, in addition to the other award criteria established for this contract, the Department will only award this contract to a bidder who makes a good faith effort to meet this goal of DBE participation in the performance of the work. A bidder makes a good faith effort for award consideration if either of the following is done in accordance with the procedures set for in this Special Provision:

(a) The bidder documents enough DBE participation has been obtained to meet the goal or,

(b) The bidder documents a good faith effort has been made to meet the goal, even though the effort did not succeed in obtaining enough DBE participation to meet the goal.

DBE LOCATOR REFERENCES. Bidders shall consult the IL UCP DBE Directory as a reference source for DBE-certified companies. In addition, the Department maintains a letting and item specific DBE locator information system whereby DBE companies can register their interest in providing quotes on particular bid items advertised for letting. Information concerning DBE companies willing to quote work for particular contracts may be obtained by contacting the Department's Bureau of Small Business Enterprises at telephone number (217) 785-4611, or by visiting the Department's website at:
http://www.idot.illinois.gov/doing-business/certifications/disadvantaged-business-enterprise-certification/il-ucp-directory/index.

BIDDING PROCEDURES. Compliance with this Special Provision is a material bidding requirement and failure of the bidder to comply will render the bid not responsive.

The bidder shall submit a DBE Utilization Plan (form SBE 2026), and a DBE Participation Statement (form SBE 2025) for each DBE company proposed for the performance of work to achieve the contract goal, with the bid. If the Utilization Plan indicates the contract goal will not be met, documentation of good faith efforts shall also be submitted. The documentation of good faith efforts must include copies of each DBE and non-DBE subcontractor quote submitted to the bidder when a non-DBE subcontractor is selected over a DBE for work on the contract. The required forms and documentation must be submitted as a single .pdf file using the "Integrated Contractor Exchange (iCX)" application within the Department's "EBids System".

The Department will not accept a Utilization Plan if it does not meet the bidding procedures set forth herein and the bid will be declared not responsive. In the event the bid is declared not responsive, the Department may elect to cause the forfeiture of the penal sum of the bidder's proposal guaranty and may deny authorization to bid the project if re-advertised for bids.

GOOD FAITH EFFORT PROCEDURES. The contract will not be awarded until the Utilization Plan is approved. All information submitted by the bidder must be complete, accurate and adequately document enough DBE participation has been obtained or document the good faith efforts of the bidder, in the event enough DBE participation has not been obtained, before the Department will commit to the performance of the contract by the bidder. The Utilization Plan will be approved by the Department if the Utilization Plan documents sufficient commercially useful DBE work to meet the contract goal or the bidder submits sufficient documentation of a good faith effort to meet the contract goal pursuant to 49 CFR Part 26, Appendix A. This means the bidder

must show that all necessary and reasonable steps were taken to achieve the contract goal. Necessary and reasonable steps are those which, by their scope, intensity and appropriateness to the objective, could reasonably be expected to obtain sufficient DBE participation, even if they were not successful. The Department will consider the quality, quantity, and intensity of the kinds of efforts the bidder has made. Mere *pro forma* efforts, in other words efforts done as a matter of form, are not good faith efforts; rather, the bidder is expected to have taken genuine efforts that would be reasonably expected of a bidder actively and aggressively trying to obtain DBE participation sufficient to meet the contract goal.

(a) The following is a list of types of action that the Department will consider as part of the evaluation of the bidder's good faith efforts to obtain participation. These listed factors are not intended to be a mandatory checklist and are not intended to be exhaustive. Other factors or efforts brought to the attention of the Department may be relevant in appropriate cases and will be considered by the Department.

(1) Soliciting through all reasonable and available means (e.g. attendance at pre-bid meetings, advertising and/or written notices) the interest of all certified DBE companies that have the capability to perform the work of the contract. The bidder must solicit this interest within sufficient time to allow the DBE companies to respond to the solicitation. The bidder must determine with certainty if the DBE companies are interested by taking appropriate steps to follow up initial solicitations.

(2) Selecting portions of the work to be performed by DBE companies in order to increase the likelihood that the DBE goals will be achieved. This includes, where appropriate, breaking out contract work items into economically feasible units to facilitate DBE participation, even when the Contractor might otherwise prefer to perform these work items with its own forces.

(3) Providing interested DBE companies with adequate information about the plans, specifications, and requirements of the contract in a timely manner to assist them in responding to a solicitation.

(4) a. Negotiating in good faith with interested DBE companies. It is the bidder's responsibility to make a portion of the work available to DBE subcontractors and suppliers and to select those portions of the work or material needs consistent with the available DBE subcontractors and suppliers, so as to facilitate DBE participation. Evidence of such negotiation includes the names, addresses, and telephone numbers of DBE companies that were considered; a description of the information provided regarding the plans and specifications for the work selected for subcontracting; and evidence as to why additional agreements could not be reached for DBE companies to perform the work.

b. A bidder using good business judgment would consider a number of factors in negotiating with subcontractors, including DBE subcontractors, and would take a firm's price and capabilities as well as contract goals into consideration. However, the fact that there may be some additional costs involved in finding and using DBE companies is not in itself sufficient reason for a bidder's failure to meet the contract DBE goal, as long as such costs are reasonable. Also the ability or desire of a bidder to perform the work of a contract with its own organization does not relieve the bidder of the responsibility to make good faith efforts. Bidders are not, however, required to accept higher quotes from DBE companies if the price

difference is excessive or unreasonable. In accordance with the above Bidding Procedures, the documentation of good faith efforts must include copies of each DBE and non-DBE subcontractor quote submitted to the bidder when a non-DBE subcontractor was selected over a DBE for work on the contract.

(5) Not rejecting DBE companies as being unqualified without sound reasons based on a thorough investigation of their capabilities. The bidder's standing within its industry, membership in specific groups, organizations, or associations and political or social affiliations (for example union vs. non-union employee status) are not legitimate causes for the rejection or non-solicitation of bids in the bidder's efforts to meet the project goal.

(6) Making efforts to assist interested DBE companies in obtaining bonding, lines of credit, or insurance as required by the recipient or Contractor.

(7) Making efforts to assist interested DBE companies in obtaining necessary equipment, supplies, materials, or related assistance or services.

(8) Effectively using the services of available minority/women community organizations; minority/women contractors' groups; local, state, and federal minority/women business assistance offices; and other organizations as allowed on a case-by-case basis to provide assistance in the recruitment and placement of DBE companies.

(b) If the Department determines the bidder has made a good faith effort to secure the work commitment of DBE companies to meet the contract goal, the Department will award the contract provided it is otherwise eligible for award. If the Department determines the bidder has failed to meet the requirements of this Special Provision or that a good faith effort has not been made, the Department will notify the responsible company official designated in the Utilization Plan that the bid is not responsive. The notification will also include a statement of reasons for the adverse determination. If the Utilization Plan is not approved because it is deficient as a technical matter, unless waived by the Department, the bidder will be notified and will be allowed no more than a five calendar day period to cure the deficiency.

(c) The bidder may request administrative reconsideration of an adverse determination by emailing the Department at "DOT.DBE.UP@illinois.gov" within the five calendar days after the receipt of the notification of the determination. The determination shall become final if a request is not made on or before the fifth calendar day. A request may provide additional written documentation or argument concerning the issues raised in the determination statement of reasons, provided the documentation and arguments address efforts made prior to submitting the bid. The request will be reviewed by the Department's Reconsideration Officer. The Reconsideration Officer will extend an opportunity to the bidder to meet in person to consider all issues of documentation and whether the bidder made a good faith effort to meet the goal. After the review by the Reconsideration Officer, the bidder will be sent a written decision within ten working days after receipt of the request for reconsideration, explaining the basis for finding that the bidder did or did not meet the goal or make adequate good faith efforts to do so. A final decision by the Reconsideration Officer that a good faith effort was made shall approve the Utilization Plan submitted by the bidder and shall clear the contract for award. A final decision that a good faith effort was not made shall render the bid not responsive.

CALCULATING DBE PARTICIPATION. The Utilization Plan values represent work anticipated to be performed and paid for upon satisfactory completion. The Department is only able to count toward the achievement of the overall goal and the contract goal the value of payments made for the work actually performed by DBE companies. In addition, a DBE must perform a commercially useful function on the contract to be counted. A commercially useful function is generally performed when the DBE is responsible for the work and is carrying out its responsibilities by actually performing, managing, and supervising the work involved. The Department and Contractor are governed by the provisions of 49 CFR Part 26.55(c) on questions of commercially useful functions as it affects the work. Specific counting guidelines are provided in 49 CFR Part 26.55, the provisions of which govern over the summary contained herein.

(a) DBE as the Contractor: 100 percent goal credit for that portion of the work performed by the DBE's own forces, including the cost of materials and supplies. Work that a DBE subcontracts to a non-DBE does not count toward the DBE goals.

(b) DBE as a joint venture Contractor: 100 percent goal credit for that portion of the total dollar value of the contract equal to the distinct, clearly defined portion of the work performed by the DBE's own forces.

(c) DBE as a subcontractor: 100 percent goal credit for the work of the subcontract performed by the DBE's own forces, including the cost of materials and supplies, excluding the purchase of materials and supplies or the lease of equipment by the DBE subcontractor from the Contractor or its affiliates. Work that a DBE subcontractor in turn subcontracts to a non-DBE does not count toward the DBE goal.

(d) DBE as a trucker: 100 percent goal credit for trucking participation provided the DBE is responsible for the management and supervision of the entire trucking operation for which it is responsible. At least one truck owned, operated, licensed, and insured by the DBE must be used on the contract. Credit will be given for the following:

(1) The DBE may lease trucks from another DBE firm, including an owner-operator who is certified as a DBE. The DBE who leases trucks from another DBE receives credit for the total value of the transportation services the lessee DBE provides on the contract.

(2) The DBE may also lease trucks from a non-DBE firm, including from an owner-operator. The DBE who leases trucks from a non-DBE is entitled to credit only for the fee or commission is receives as a result of the lease arrangement.

(e) DBE as a material supplier:

(1) 60 percent goal credit for the cost of the materials or supplies purchased from a DBE regular dealer.

(2) 100 percent goal credit for the cost of materials of supplies obtained from a DBE manufacturer.

(3) 100 percent credit for the value of reasonable fees and commissions for the procurement of materials and supplies if not a DBE regular dealer or DBE manufacturer.

CONTRACT COMPLIANCE. Compliance with this Special Provision is an essential part of the contract. The Department is prohibited by federal regulations from crediting the participation of a DBE included in the Utilization Plan toward either the contract goal or the Department's overall goal until the amount to be applied toward the goals has been paid to the DBE. The following administrative procedures and remedies govern the compliance by the Contractor with the contractual obligations established by the Utilization Plan. After approval of the Utilization Plan and award of the contract, the Utilization Plan and individual DBE Participation Statements become part of the contract. If the Contractor did not succeed in obtaining enough DBE participation to achieve the advertised contract goal, and the Utilization Plan was approved and contract awarded based upon a determination of good faith, the total dollar value of DBE work calculated in the approved Utilization Plan as a percentage of the awarded contract value shall become the amended contract goal. All work indicated for performance by an approved DBE shall be performed, managed, and supervised by the DBE executing the DBE Participation Commitment Statement.

(a) NO AMENDMENT. No amendment to the Utilization Plan may be made without prior written approval from the Department's Bureau of Small Business Enterprises. All requests for amendment to the Utilization Plan shall be emailed to the Department at DOT.DBE.UP@illinois.gov.

(b) CHANGES TO WORK. Any deviation from the DBE condition-of-award or contract plans, specifications, or special provisions must be approved, in writing, by the Department as provided elsewhere in the Contract. The Contractor shall notify affected DBEs in writing of any changes in the scope of work which result in a reduction in the dollar amount condition-of-award to the contract. Where the revision includes work committed to a new DBE subcontractor, not previously involved in the project, then a Request for Approval of Subcontractor, Department form BC 260A or AER 260A, must be signed and submitted. If the commitment of work is in the form of additional tasks assigned to an existing subcontract, a new Request for Approval of Subcontractor will not be required. However, the Contractor must document efforts to assure the existing DBE subcontractor is capable of performing the additional work and has agreed in writing to the change.

(c) SUBCONTRACT. The Contractor must provide copies of DBE subcontracts to the Department upon request. Subcontractors shall ensure that all lower tier subcontracts or agreements with DBEs to supply labor or materials be performed in accordance with this Special Provision.

(d) ALTERNATIVE WORK METHODS. In addition to the above requirements for reductions in the condition of award, additional requirements apply to the two cases of Contractor-initiated work substitution proposals. Where the contract allows alternate work methods which serve to delete or create underruns in condition of award DBE work, and the Contractor selects that alternate method or, where the Contractor proposes a substitute work method or material that serves to diminish or delete work committed to a DBE and replace it with other work, then the Contractor must demonstrate one of the following:

(1) The replacement work will be performed by the same DBE (as long as the DBE is certified in the respective item of work) in a modification of the condition of award; or

(2) The DBE is aware its work will be deleted or will experience underruns and has agreed in writing to the change. If this occurs, the Contractor shall substitute other work of

equivalent value to a certified DBE or provide documentation of good faith efforts to do so; or

(3) The DBE is not capable of performing the replacement work or has declined to perform the work at a reasonable competitive price. If this occurs, the Contractor shall substitute other work of equivalent value to a certified DBE or provide documentation of good faith efforts to do so.

(e) TERMINATION AND REPLACEMENT PROCEDURES. The Contractor shall not terminate or replace a DBE listed on the approved Utilization Plan, or perform with other forces work designated for a listed DBE except as provided in this Special Provision. The Contractor shall utilize the specific DBEs listed to perform the work and supply the materials for which each is listed unless the Contractor obtains the Department's written consent as provided in subsection (a) of this part. Unless Department consent is provided for termination of a DBE subcontractor, the Contractor shall not be entitled to any payment for work or material unless it is performed or supplied by the DBE in the Utilization Plan.

As stated above, the Contractor shall not terminate or replace a DBE subcontractor listed in the approved Utilization Plan without prior written consent. This includes, but is not limited to, instances in which the Contractor seeks to perform work originally designated for a DBE subcontractor with its own forces or those of an affiliate, a non-DBE firm, or with another DBE firm. Written consent will be granted only if the Bureau of Small Business Enterprises agrees, for reasons stated in its concurrence document, that the Contractor has good cause to terminate or replace the DBE firm. Before transmitting to the Bureau of Small Business Enterprises any request to terminate and/or substitute a DBE subcontractor, the Contractor shall give notice in writing to the DBE subcontractor, with a copy to the Bureau, of its intent to request to terminate and/or substitute, and the reason for the request. The Contractor shall give the DBE five days to respond to the Contractor's notice. The DBE so notified shall advise the Bureau and the Contractor of the reasons, if any, why it objects to the proposed termination of its subcontract and why the Bureau should not approve the Contractor's action. If required in a particular case as a matter of public necessity, the Bureau may provide a response period shorter than five days.

For purposes of this paragraph, good cause includes the following circumstances:

(1) The listed DBE subcontractor fails or refuses to execute a written contract;

(2) The listed DBE subcontractor fails or refuses to perform the work of its subcontract in a way consistent with normal industry standards. Provided, however, that good cause does not exist if the failure or refusal of the DBE subcontractor to perform its work on the subcontract results from the bad faith or discriminatory action of the Contractor;

(3) The listed DBE subcontractor fails or refuses to meet the Contractor's reasonable, nondiscriminatory bond requirements;

(4) The listed DBE subcontractor becomes bankrupt, insolvent, or exhibits credit unworthiness;

(5) The listed DBE subcontractor is ineligible to work on public works projects because of suspension and debarment proceedings pursuant 2 CFR Parts 180, 215 and 1200 or applicable state law.

(6) The Contractor has determined the listed DBE subcontractor is not a responsible contractor;

(7) The listed DBE subcontractor voluntarily withdraws from the projects and provides written notice to the Contractor of its withdrawal;

(8) The listed DBE is ineligible to receive DBE credit for the type of work required;

(9) A DBE owner dies or becomes disabled with the result that the listed DBE subcontractor is unable to complete its work on the contract;

(10) Other documented good cause that compels the termination of the DBE subcontractor. Provided, that good cause does not exist if the Contractor seeks to terminate a DBE it relied upon to obtain the contract so that the Contractor can self-perform the work for which the DBE contractor was engaged or so that the Contractor can substitute another DBE or non-DBE contractor after contract award.

When a DBE is terminated or fails to complete its work on the Contract for any reason, the Contractor shall make a good faith effort to find another DBE to substitute for the original DBE to perform at least the same amount of work under the contract as the terminated DBE to the extent needed to meet the established Contract goal. The good faith efforts shall be documented by the Contractor. If the Department requests documentation under this provision, the Contractor shall submit the documentation within seven days, which may be extended for an additional seven days if necessary at the request of the Contractor. The Department will provide a written determination to the Contractor stating whether or not good faith efforts have been demonstrated.

(f) FINAL PAYMENT. After the performance of the final item of work or delivery of material by a DBE and final payment therefore to the DBE by the Contractor, but not later than 30 calendar days after payment has been made by the Department to the Contractor for such work or material, the Contractor shall submit a DBE Payment Agreement on Department form SBE 2115 to the Resident Engineer. If full and final payment has not been made to the DBE, the DBE Payment Agreement shall indicate whether a disagreement as to the payment required exists between the Contractor and the DBE or if the Contractor believes the work has not been satisfactorily completed. If the Contractor does not have the full amount of work indicated in the Utilization Plan performed by the DBE companies indicated in the Utilization Plan and after good faith efforts are reviewed, the Department may deduct from contract payments to the Contractor the amount of the goal not achieved as liquidated and ascertained damages. The Contractor may request an administrative reconsideration of any amount deducted as damages pursuant to subsection (h) of this part.

(g) ENFORCEMENT. The Department reserves the right to withhold payment to the Contractor to enforce the provisions of this Special Provision. Final payment shall not be made on the contract until such time as the Contractor submits sufficient documentation demonstrating achievement of the goal in accordance with this Special Provision or after liquidated damages have been determined and collected.

(h) RECONSIDERATION. Notwithstanding any other provision of the contract, including but not limited to Article 109.09 of the Standard Specifications, the Contractor may request

administrative reconsideration of a decision to deduct the amount of the goal not achieved as liquidated damages. A request to reconsider shall be delivered to the Contract Compliance Section and shall be handled and considered in the same manner as set forth in paragraph (c) of "Good Faith Effort Procedures" of this Special Provision, except a final decision that a good faith effort was not made during contract performance to achieve the goal agreed to in the Utilization Plan shall be the final administrative decision of the Department. The result of the reconsideration process is not administratively appealable to the U.S. Department of Transportation.

ILLINOIS WORKS APPRENTICESHIP INITIATIVE – STATE FUNDED CONTRACTS (BDE)

Effective: June 2, 2021
Revised: September 2, 2021

Illinois Works Jobs Program Act (30 ILCS 559/20-1 et seq.). For contracts having an awarded contract value of $500,000 or more, the Contractor shall comply with the Illinois Works Apprenticeship Initiative (30 ILCS 559/20-20 to 20-25) and all applicable administrative rules. The goal of the Illinois Apprenticeship Works Initiative is that apprentices will perform either 10% of the total labor hours actually worked in each prevailing wage classification or 10% of the estimated labor hours in each prevailing wage classification, whichever is less. The Contractor may seek from the Department of Commerce and Economic Opportunity (DCEO) a waiver or reduction of this goal in certain circumstances pursuant to 30 ILCS 559/20-20(b). The Contractor shall ensure compliance during the term of the contract and will be required to report on and certify its compliance. An apprentice use plan, apprentice hours, and a compliance certification shall be submitted to the Engineer on forms provided by the Department and/or DCEO.

PERFORMANCE GRADED ASPHALT BINDER (BDE)

Effective: January 1, 2023

Revise Article 1032.05 of the Standard Specifications to read:

"**1032.05 Performance Graded Asphalt Binder.** These materials will be accepted according to the Bureau of Materials Policy Memorandum, "Performance Graded Asphalt Binder Qualification Procedure." The Department will maintain a qualified producer list. These materials shall be free from water and shall not foam when heated to any temperature below the actual flash point. Air blown asphalt, recycle engine oil bottoms (ReOB), and polyphosphoric acid (PPA) modification shall not be used.

When requested, producers shall provide the Engineer with viscosity/temperature relationships for the performance graded asphalt binders delivered and incorporated in the work.

(a) Performance Graded (PG) Asphalt Binder. The asphalt binder shall meet the requirements of AASHTO M 320, Table 1 "Standard Specification for Performance Graded Asphalt Binder" for the grade shown on the plans and the following.

Test	Parameter
Small Strain Parameter (AASHTO PP 113) BBR, ΔTc, 40 hrs PAV (40 hrs continuous or 2 PAV at 20 hrs)	-5 °C min.

(b) Modified Performance Graded (PG) Asphalt Binder. The asphalt binder shall meet the requirements of AASHTO M 320, Table 1 "Standard Specification for Performance Graded Asphalt Binder" for the grade shown on the plans.

Asphalt binder modification shall be performed at the source, as defined in the Bureau of Materials Policy Memorandum, "Performance Graded Asphalt Binder Qualification Procedure."

Modified asphalt binder shall be safe to handle at asphalt binder production and storage temperatures or HMA construction temperatures. Safety Data Sheets (SDS) shall be provided for all asphalt modifiers.

(1) Polymer Modification (SB/SBS or SBR). Elastomers shall be added to the base asphalt binder to achieve the specified performance grade and shall be either a styrene-butadiene diblock, triblock copolymer without oil extension, or a styrene-butadiene rubber. The polymer modified asphalt binder shall be smooth, homogeneous, and be according to the requirements shown in Table 1 or 2 for the grade shown on the plans.

Table 1 - Requirements for Styrene-Butadiene Copolymer (SB/SBS) Modified Asphalt Binders		
Test	Asphalt Grade SB/SBS PG 64-28 SB/SBS PG 70-22	Asphalt Grade SB/SBS PG 64-34 SB/SBS PG 70-28 SB/SBS PG 76-22 SB/SBS PG 76-28
Separation of Polymer ITP, "Separation of Polymer from Asphalt Binder" Difference in °F (°C) of the softening point between top and bottom portions	4 (2) max.	4 (2) max.
TESTS ON RESIDUE FROM ROLLING THIN FILM OVEN TEST (AASHTO T 240)		
Elastic Recovery ASTM D 6084, Procedure A, 77 °F (25 °C), 100 mm elongation, %	60 min.	70 min.

Table 2 - Requirements for Styrene-Butadiene Rubber (SBR) Modified Asphalt Binders		
Test	Asphalt Grade SBR PG 64-28 SBR PG 70-22	Asphalt Grade SB/SBS PG 64-34 SB/SBS PG 70-28 SBR PG 76-22 SBR PG 76-28
Separation of Polymer ITP, "Separation of Polymer from Asphalt Binder" Difference in °F (°C) of the softening point between top and bottom portions	4 (2) max.	4 (2) max.
Toughness ASTM D 5801, 77 °F (25 °C), 20 in./min. (500 mm/min.), in.-lbs (N-m)	110 (12.5) min.	110 (12.5) min.
Tenacity ASTM D 5801, 77 °F (25 °C), 20 in./min. (500 mm/min.), in.-lbs (N-m)	75 (8.5) min.	75 (8.5) min.
TESTS ON RESIDUE FROM ROLLING THIN FILM OVEN TEST (AASHTO T 240)		
Elastic Recovery ASTM D 6084, Procedure A, 77 °F (25 °C), 100 mm elongation, %	40 min.	50 min.

(2) Ground Tire Rubber (GTR) Modification. GTR modification is the addition of recycled ground tire rubber to liquid asphalt binder to achieve the specified performance grade. GTR shall be produced from processing automobile and/or truck tires by the ambient grinding method or micronizing through a cryogenic process. GTR shall not exceed 1/16 in. (2 mm) in any dimension and shall not contain free metal particles, moisture that would cause foaming of the asphalt, or other foreign materials. A mineral powder (such as talc) meeting the requirements of AASHTO M 17 may be added, up to a maximum of four percent by weight of GTR to reduce sticking and caking of the GTR particles. When tested in accordance with Illinois Modified AASHTO T 27 “Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates” or AASHTO PP 74 “Standard Practice for Determination of Size and Shape of Glass Beads Used in Traffic Markings by Means of Computerized Optical Method”, a 50 g sample of the GTR shall conform to the following gradation requirements.

Sieve Size	Percent Passing
No. 16 (1.18 mm)	100
No. 30 (600 µm)	95 ± 5
No. 50 (300 µm)	> 20

GTR modified asphalt binder shall be tested for rotational viscosity according to AASHTO T 316 using spindle S27. GTR modified asphalt binder shall be tested for original dynamic shear and RTFO dynamic shear according to AASHTO T 315 using a gap of 2 mm.

The GTR modified asphalt binder shall meet the requirements of Table 3.

Table 3 - Requirements for Ground Tire Rubber (GTR) Modified Asphalt Binders		
Test	Asphalt Grade GTR PG 64-28 GTR PG 70-22	Asphalt Grade GTR PG 76-22 GTR PG 76-28 GTR PG 70-28
TESTS ON RESIDUE FROM ROLLING THIN FILM OVEN TEST (AASHTO T 240)		
Elastic Recovery ASTM D 6084, Procedure A, 77 °F (25 °C), 100 mm elongation, %	60 min.	70 min.

(3) Softener Modification (SM). Softener modification is the addition of organic compounds, such as engineered flux, bio-oil blends, modified vegetable oils, glycol amines, and fatty acid derivatives, to the base asphalt binder to achieve the specified performance grade. Softeners shall be dissolved, dispersed, or reacted in the asphalt binder to enhance its performance and shall remain compatible with the asphalt binder with no separation. Softeners shall not be added to modified PG asphalt binder as defined in Articles 1032.05(b)(1) or 1032.05(b)(2).

An Attenuated Total Reflectance-Fourier Transform Infrared spectrum (ATR-FTIR) shall be collected for both the softening compound as well as the softener modified asphalt binder at the dose intended for qualification. The ATR-FTIR spectra shall be collected on unaged softener modified binder, 20-hour Pressurized Aging Vessel (PAV) aged softener modified binder, and 40-hour PAV aged softener modified binder. The ATR-FTIR shall be collected in accordance with Illinois Test Procedure 601. The electronic files spectral files (in one of the following extensions or equivalent: *.SPA, *.SPG, *.IRD, *.IFG, *.CSV, *.SP, *.IRS, *.GAML, *.[0-9], *.IGM, *.ABS, *.DRT, *.SBM, *.RAS) shall be submitted to the Central Bureau of Materials.

Softener modified asphalt binders shall meet the requirements in Table 4.

Table 4 - Requirements for Softener Modified Asphalt Binders	
Test	Asphalt Grade SM PG 46-28 SM PG 46-34 SM PG 52-28 SM PG 52-34 SM PG 58-22 SM PG 58-28 SM PG 64-22
Small Strain Parameter (AASHTO PP 113) BBR, ΔTc, 40 hrs PAV (40 hrs continuous or 2 PAV at 20 hrs)	-5°C min.
Large Strain Parameter (Illinois Modified AASHTO T 391) DSR/LAS Fatigue Property, Δ|G*|peak τ, 40 hrs PAV (40 hrs continuous or 2 PAV at 20 hrs)	≥ 54 %

The following grades may be specified as tack coats.

Asphalt Grade	Use
PG 58-22, PG 58-28, PG 64-22	Tack Coat"

Revise Article 1031.06(c)(1) and 1031.06(c)(2) of the Standard Specifications to read:

"(1) RAP/RAS. When RAP is used alone or RAP is used in conjunction with RAS, the percentage of virgin ABR shall not exceed the amounts listed in the following table.

HMA Mixtures - RAP/RAS Maximum ABR % 1/ 2/			
Ndesign	Binder	Surface	Polymer Modified Binder or Surface 3/
30	30	30	10
50	25	15	10
70	15	10	10
90	10	10	10

1/ For Low ESAL HMA shoulder and stabilized subbase, the RAP/RAS ABR shall not exceed 50 percent of the mixture.

2/ When RAP/RAS ABR exceeds 20 percent, the high and low virgin asphalt binder grades shall each be reduced by one grade (i.e. 25 percent ABR would require a virgin asphalt binder grade of PG 64-22 to be reduced to a PG 58-28).

3/ The maximum ABR percentages for ground tire rubber (GTR) modified mixes shall be equivalent to the percentages specified for SBS/SBR polymer modified mixes.

(2) FRAP/RAS. When FRAP is used alone or FRAP is used in conjunction with RAS, the percentage of virgin asphalt binder replacement shall not exceed the amounts listed in the following table.

HMA Mixtures - FRAP/RAS Maximum ABR % 1/ 2/			
Ndesign	Binder	Surface	Polymer Modified Binder or Surface 3/
30	55	45	15
50	45	40	15
70	45	35	15
90	45	35	15
SMA	- -	- -	25
IL-4.75	- -	- -	35

1/ For Low ESAL HMA shoulder and stabilized subbase, the FRAP/RAS ABR shall not exceed 50 percent of the mixture.

2/ When FRAP/RAS ABR exceeds 20 percent for all mixes, the high and low virgin asphalt binder grades shall each be reduced by one grade (i.e. 25 percent ABR would require a virgin asphalt binder grade of PG 64-22 to be reduced to a PG 58-28).

3/ The maximum ABR percentages for GTR modified mixes shall be equivalent to the percentages specified for SBS/SBR polymer modified mixes."

Add the following to the end of Note 2 of Article 1030.03 of the Standard Specifications.

"A dedicated storage tank for the ground tire rubber (GTR) modified asphalt binder shall be provided. This tank shall be capable of providing continuous mechanical mixing throughout and/or recirculation of the asphalt binder to provide a uniform mixture. The tank shall be heated and capable of maintaining the temperature of the asphalt binder at 300 °F to 350 °F (149 °C to 177 °C). The asphalt binder metering systems of dryer drum plants shall be calibrated with the actual GTR modified asphalt binder material with an accuracy of ±0.40 percent."

SEEDING (BDE)

Effective: November 1, 2022

Revise Article 250.07 of the Standard Specifications to read:

"**250.07 Seeding Mixtures.** The classes of seeding mixtures and combinations of mixtures will be designated in the plans.

When an area is to be seeded with two or more seeding classes, those mixtures shall be applied separately on the designated area within a seven day period. Seeding shall occur prior to placement of mulch cover. A Class 7 mixture can be applied at any time prior to applying any seeding class or added to them and applied at the same time.

TABLE 1 - SEEDING MIXTURES			
Class -	Type	Seeds	lb/acre (kg/hectare)
1	Lawn Mixture 1/	Kentucky Bluegrass	100 (110)
		Perennial Ryegrass	60 (70)
		Festuca rubra ssp. *rubra* (Creeping Red Fescue)	40 (50)
1A	Salt Tolerant	Kentucky Bluegrass	60 (70)
	Lawn Mixture 1/	Perennial Ryegrass	20 (20)
		Festuca rubra ssp. *rubra* (Creeping Red Fescue)	20 (20)
		Festuca brevipilla (Hard Fescue)	20 (20)
		Puccinellia distans (Fults Saltgrass or Salty Alkaligrass)	60 (70)
1B	Low Maintenance	Turf-Type Fine Fescue 3/	150 (170)
	Lawn Mixture 1/	Perennial Ryegrass	20 (20)
		Red Top	10 (10)
		Festuca rubra ssp. *rubra* (Creeping Red Fescue)	20 (20)
2	Roadside Mixture 1/	*Lolium arundinaceum* (Tall Fescue)	100 (110)
		Perennial Ryegrass	50 (55)
		Festuca rubra ssp. *rubra* (Creeping Red Fescue)	40 (50)
		Red Top	10 (10)
2A	Salt Tolerant	*Lolium arundinaceum* (Tall Fescue)	60 (70)
	Roadside Mixture 1/	Perennial Ryegrass	20 (20)
		Festuca rubra ssp. *rubra* (Creeping Red Fescue)	30 (20)
		Festuca brevipila (Hard Fescue)	30 (20)
		Puccinellia distans (Fults Saltgrass or Salty Alkaligrass)	60 (70)
3	Northern Illinois	*Elymus canadensis*	5 (5)
	Slope Mixture 1/	(Canada Wild Rye) 5/	
		Perennial Ryegrass	20 (20)
		Alsike Clover 4/	5 (5)
		Desmanthus illinoensis	2 (2)
		(Illinois Bundleflower) 4/ 5/	
		Schizachyrium scoparium	12 (12)
		(Little Bluestem) 5/	
		Bouteloua curtipendula	10 (10)
		(Side-Oats Grama) 5/	
		Puccinellia distans (Fults Saltgrass or Salty Alkaligrass)	30 (35)
		Oats, Spring	50 (55)
		Slender Wheat Grass 5/	15 (15)
		Buffalo Grass 5/ 7/	5 (5)
3A	Southern Illinois	Perennial Ryegrass	20 (20)
	Slope Mixture 1/	*Elymus canadensis*	20 (20)
		(Canada Wild Rye) 5/	
		Panicum virgatum (Switchgrass) 5/	10 (10)
		Schizachyrium scoparium	12 (12)
		(Little Blue Stem) 5/	
		Bouteloua curtipendula	10 (10)
		(Side-Oats Grama) 5/	
		Dalea candida	5 (5)
		(White Prairie Clover) 4/ 5/	
		Rudbeckia hirta (Black-Eyed Susan) 5/	5 (5)
		Oats, Spring	50 (55)

Class – Type		Seeds	lb/acre (kg/hectare)
4	Native Grass 2/ 6/	*Andropogon gerardi* (Big Blue Stem) 5/	4 (4)
		Schizachyrium scoparium (Little Blue Stem) 5/	5 (5)
		Bouteloua curtipendula (Side-Oats Grama) 5/	5 (5)
		Elymus canadensis (Canada Wild Rye) 5/	1 (1)
		Panicum virgatum (Switch Grass) 5/	1 (1)
		Sorghastrum nutans (Indian Grass) 5/	2 (2)
		Annual Ryegrass	25 (25)
		Oats, Spring	25 (25)
		Perennial Ryegrass	15 (15)
4A	Low Profile Native Grass 2/ 6/	*Schizachyrium scoparium* (Little Blue Stem) 5/	5 (5)
		Bouteloua curtipendula (Side-Oats Grama) 5/	5 (5)
		Elymus canadensis (Canada Wild Rye) 5/	1 (1)
		Sporobolus heterolepis (Prairie Dropseed) 5/	0.5 (0.5)
		Annual Ryegrass	25 (25)
		Oats, Spring	25 (25)
		Perennial Ryegrass	15 (15)
4B	Wetland Grass and Sedge Mixture 2/ 6/	Annual Ryegrass	25 (25)
		Oats, Spring	25 (25)
		Wetland Grasses (species below) 5/	6 (6)

Species:	% By Weight
Calamagrostis canadensis (Blue Joint Grass)	12
Carex lacustris (Lake-Bank Sedge)	6
Carex slipata (Awl-Fruited Sedge)	6
Carex stricta (Tussock Sedge)	6
Carex vulpinoidea (Fox Sedge)	6
Eleocharis acicularis (Needle Spike Rush)	3
Eleocharis obtusa (Blunt Spike Rush)	3
Glyceria striata (Fowl Manna Grass)	14
Juncus effusus (Common Rush)	6
Juncus tenuis (Slender Rush)	6
Juncus torreyi (Torrey's Rush)	6
Leersia oryzoides (Rice Cut Grass)	10
Scirpus acutus (Hard-Stemmed Bulrush)	3
Scirpus atrovirens (Dark Green Rush)	3
Bolboschoenus fluviatilis (River Bulrush)	3
Schoenoplectus tabernaemontani (Softstem Bulrush)	3
Spartina pectinata (Cord Grass)	4

Class – Type	Seeds	lb/acre (kg/hectare)
5 Forb with Annuals Mixture 2/ 5/ 6/	Annuals Mixture (Below)	1 (1)
	Forb Mixture (Below)	10 (10)

Annuals Mixture - Mixture not exceeding 25 % by weight of any one species, of the following:

Coreopsis lanceolata (Sand Coreopsis)
Leucanthemum maximum (Shasta Daisy)
Gaillardia pulchella (Blanket Flower)
Ratibida columnifera (Prairie Coneflower)
Rudbeckia hirta (Black-Eyed Susan)

Forb Mixture - Mixture not exceeding 5 % by weight PLS of any one species, of the following:

Amorpha canescens (Lead Plant) 4/
Anemone cylindrica (Thimble Weed)
Asclepias tuberosa (Butterfly Weed)
Aster azureus (Sky Blue Aster)
Symphyotrichum leave (Smooth Aster)
Aster novae-angliae (New England Aster)
Baptisia leucantha (White Wild Indigo) 4/
Coreopsis palmata (Prairie Coreopsis)
Echinacea pallida (Pale Purple Coneflower)
Eryngium yuccifolium (Rattlesnake Master)
Helianthus mollis (Downy Sunflower)
Heliopsis helianthoides (Ox-Eye)
Liatris aspera (Rough Blazing Star)
Liatris pycnostachya (Prairie Blazing Star)
Monarda fistulosa (Prairie Bergamot)
Parthenium integrifolium (Wild Quinine)
Dalea candida (White Prairie Clover) 4/
Dalea purpurea (Purple Prairie Clover) 4/
Physostegia virginiana (False Dragonhead)
Potentilla arguta (Prairie Cinquefoil)
Ratibida pinnata (Yellow Coneflower)
Rudbeckia subtomentosa (Fragrant Coneflower)
Silphium laciniatum (Compass Plant)
Silphium terebinthinaceum (Prairie Dock)
Oligoneuron rigidum (Rigid Goldenrod)
Tradescantia ohiensis (Spiderwort)
Veronicastrum virginicum (Culver's Root)

Class – Type		Seeds	lb/acre (kg/hectare)
5A	Large Flower Native Forb Mixture 2/ 5/ 6/	Forb Mixture (see below)	5 (5)
		Species:	% By Weight
		Aster novae-angliae (New England Aster)	5
		Echinacea pallida (Pale Purple Coneflower)	10
		Helianthus mollis (Downy Sunflower)	10
		Heliopsis helianthoides (Ox-Eye)	10
		Liatris pycnostachya (Prairie Blazing Star)	10
		Ratibida pinnata (Yellow Coneflower)	5
		Rudbeckia hirta (Black-Eyed Susan)	10
		Silphium laciniatum (Compass Plant)	10
		Silphium terebinthinaceum (Prairie Dock)	20
		Oligoneuron rigidum (Rigid Goldenrod)	10
5B	Wetland Forb 2/ 5/ 6/	Forb Mixture (see below)	2 (2)
		Species:	% By Weight
		Acorus calamus (Sweet Flag)	3
		Angelica atropurpurea (Angelica)	6
		Asclepias incarnata (Swamp Milkweed)	2
		Aster puniceus (Purple Stemmed Aster)	10
		Bidens cernua (Beggarticks)	7
		Eutrochium maculatum (Spotted Joe Pye Weed)	7
		Eupatorium perfoliatum (Boneset)	7
		Helenium autumnale (Autumn Sneeze Weed)	2
		Iris virginica shrevei (Blue Flag Iris)	2
		Lobelia cardinalis (Cardinal Flower)	5
		Lobelia siphilitica (Great Blue Lobelia)	5
		Lythrum alatum (Winged Loosestrife)	2
		Physostegia virginiana (False Dragonhead)	5
		Persicaria pensylvanica (Pennsylvania Smartweed)	10
		Persicaria lapathifolia (Curlytop Knotweed)	10
		Pychanthemum virginianum (Mountain Mint)	5
		Rudbeckia laciniata (Cut-leaf Coneflower)	5
		Oligoneuron riddellii (Riddell Goldenrod)	2
		Sparganium eurycarpum (Giant Burreed)	5
6	Conservation Mixture 2/ 6/	*Schizachyrium scoparium* (Little Blue Stem) 5/	5 (5)
		Elymus canadensis (Canada Wild Rye) 5/	2 (2)
		Buffalo Grass 5/ 7/	5 (5)
		Vernal Alfalfa 4/	15 (15)
		Oats, Spring	48 (55)
6A	Salt Tolerant Conservation Mixture 2/ 6/	*Schizachyrium scoparium* (Little Blue Stem) 5/	5 (5)
		Elymus canadensis (Canada Wild Rye) 5/	2 (2)
		Buffalo Grass 5/ 7/	5 (5)
		Vernal Alfalfa 4/	15 (15)
		Oats, Spring	48 (55)
		Puccinellia distans (Fults Saltgrass or Salty Alkaligrass)	20 (20)
7	Temporary Turf Cover Mixture	Perennial Ryegrass	50 (55)
		Oats, Spring	64 (70)

Notes:

1/ Seeding shall be performed when the ambient temperature has been between 45 ºF (7 ºC) and 80 ºF (27 ºC) for a minimum of seven (7) consecutive days and is forecasted to be the same for the next five (5) days according to the National Weather Service.
2/ Seeding shall be performed in late fall through spring beginning when the ambient temperature has been below 45 ºF (7 ºC) for a minimum of seven (7) consecutive days and ending when the ambient temperature exceeds 80 ºF (27 ºC) according to the National Weather Service.
3/ Specific variety as shown in the plans or approved by the Engineer.
4/ Inoculation required.
5/ Pure Live Seed (PLS) shall be used.
6/ Fertilizer shall not be used.
7/ Seed shall be primed with KNO_3 to break dormancy and dyed to indicate such.

Seeding will be inspected after a period of establishment. The period of establishment shall be six (6) months minimum, but not to exceed nine (9) months. After the period of establishment, areas not exhibiting 75 percent uniform growth shall be interseeded or reseeded, as determined by the Engineer, at no additional cost to the Department."

SPEED DISPLAY TRAILER (BDE)

Effective: April 2, 2014 Revised: January 1, 2022

Revise the last paragraph of Article 701.11 of the Standard Specifications to read:

"When not being utilized to inform and direct traffic, sign trailers, speed display trailers, arrow boards, and portable changeable message boards shall be treated as nonoperating equipment."

Add the following to Article 701.15 of the Standard Specifications:

"(m) Speed Display Trailer. A speed display trailer is used to enhance safety of the traveling public and workers in work zones by alerting drivers of their speed, thus deterring them from driving above the posted work zone speed limit."

Add the following to Article 701.20 of the Standard Specifications:

"(k) When speed display trailers are shown on the Standard, this work will not be paid for separately but shall be considered as included in the cost of the Standard.

For all other speed display trailers, this work will be paid for at the contract unit price per calendar month or fraction thereof for each trailer as SPEED DISPLAY TRAILER."

Add the following to Article 1106.02 of the Standard Specifications:

"(o) Speed Display Trailer. The speed display trailer shall consist of a LED speed indicator display with self-contained, one-direction radar mounted on an orange see-through trailer. The height of the display and radar shall be such that it will function and be visible when located behind concrete barrier.

The speed measurement shall be by radar and provide a minimum detection distance of 1000 ft (300 m). The radar shall have an accuracy of ±1 mile per hour.

The speed indicator display shall face approaching traffic and shall have a sign legend of "YOUR SPEED" immediately above or below the speed display. The sign letters shall be between 5 and 8 in. (125 and 200 mm) in height. The digital speed display shall show two digits (00 to 99) in mph. The color of the changeable message legend shall be a yellow legend on a black background. The minimum height of the numerals shall be 18 in. (450 mm), and the nominal legibility distance shall be at least 750 ft (250 m).

The speed indicator display shall be equipped with a violation alert that flashes the displayed detected speed when the work zone posted speed limit is exceeded. The speed indicator shall have a maximum speed cutoff. On roadway facilities with a normal posted speed limit greater than or equal to 45 mph, the detected speeds of vehicles traveling more than 25 mph over the work zone speed limit shall not be displayed. On facilities with normal posted speed limit of less than 45 mph, the detected speeds of vehicles traveling more than 15 mph over the work zone speeds limit shall not be displayed. On any roadway facility if detected speeds are less than 25 mph, they shall not be displayed. The display shall include automatic dimming for nighttime operation.

The speed indicator measurement and display functions shall be equipped with the power supply capable of providing 24 hours of uninterrupted service."

STEEL COST ADJUSTMENT (BDE)

Effective: April 2, 2004 Revised: January 1, 2022

Description. Steel cost adjustments will be made to provide additional compensation to the Contractor, or a credit to the Department, for fluctuations in steel prices when optioned by the Contractor. The bidder shall indicate with their bid whether or not this special provision will be part of the contract. Failure to indicate "Yes" for any item of work will make that item of steel exempt from steel cost adjustment.

Types of Steel Products. An adjustment will be made for fluctuations in the cost of steel used in the manufacture of the following items:

Metal Piling (excluding temporary sheet piling)
Structural Steel
Reinforcing Steel

Other steel materials such as dowel bars, tie bars, welded reinforcement, guardrail, steel traffic signal and light poles, towers and mast arms, metal railings (excluding wire fence), and frames and grates will be subject to a steel cost adjustment when the pay items they are used in have a contract value of $10,000 or greater.

The adjustments shall apply to the above items when they are part of the original proposed construction, or added as extra work and paid for by agreed unit prices. The adjustments shall

not apply when the item is added as extra work and paid for at a lump sum price or by force account.

Documentation. Sufficient documentation shall be furnished to the Engineer to verify the following:

(a) The dates and quantity of steel, in lb (kg), shipped from the mill to the fabricator.

(b) The quantity of steel, in lb (kg), incorporated into the various items of work covered by this special provision. The Department reserves the right to verify submitted quantities.

Method of Adjustment. Steel cost adjustments will be computed as follows:

$SCA = Q \times D$

Where: SCA = steel cost adjustment, in dollars
Q = quantity of steel incorporated into the work, in lb (kg)
D = price factor, in dollars per lb (kg)

$D = MPI_M - MPI_L$

Where: MPI_M = The Materials Cost Index for steel as published by the Engineering News-Record for the month the steel is shipped from the mill. The indices will be converted from dollars per 100 lb to dollars per lb (kg).

MPI_L = The Materials Cost Index for steel as published by the Engineering News-Record for the month prior to the letting for work paid for at the contract price; or for the month the agreed unit price letter is submitted by the Contractor for extra work paid for by agreed unit price,. The indices will be converted from dollars per 100 lb to dollars per lb (kg).

The unit weights (masses) of steel that will be used to calculate the steel cost adjustment for the various items are shown in the attached table.

No steel cost adjustment will be made for any products manufactured from steel having a mill shipping date prior to the letting date.

If the Contractor fails to provide the required documentation, the method of adjustment will be calculated as described above; however, the MPI_M will be based on the date the steel arrives at the job site. In this case, an adjustment will only be made when there is a decrease in steel costs.

Basis of Payment. Steel cost adjustments may be positive or negative but will only be made when there is a difference between the MPI_L and MPI_M in excess of five percent, as calculated by:

$$\text{Percent Difference} = \{(MPI_L - MPI_M) \div MPI_L\} \times 100$$

Steel cost adjustments will be calculated by the Engineer and will be paid or deducted when all other contract requirements for the items of work are satisfied. Adjustments will only be made for fluctuations in the cost of the steel as described herein. No adjustment will be made for changes in the cost of manufacturing, fabrication, shipping, storage, etc.

The adjustments shall not apply during contract time subject to liquidated damages for completion of the entire contract.

Attachment

Item	Unit Mass (Weight)
Metal Piling (excluding temporary sheet piling)	
Furnishing Metal Pile Shells 12 in. (305 mm), 0.179 in. (3.80 mm) wall thickness)	23 lb/ft (34 kg/m)
Furnishing Metal Pile Shells 12 in. (305 mm), 0.250 in. (6.35 mm) wall thickness)	32 lb/ft (48 kg/m)
Furnishing Metal Pile Shells 14 in. (356 mm), 0.250 in. (6.35 mm) wall thickness)	37 lb/ft (55 kg/m)
Other piling	See plans
Structural Steel	See plans for weights (masses)
Reinforcing Steel	See plans for weights (masses)
Dowel Bars and Tie Bars	6 lb (3 kg) each
Welded Reinforcement	63 lb/100 sq ft (310 kg/sq m)
Guardrail	
Steel Plate Beam Guardrail, Type A w/steel posts	20 lb/ft (30 kg/m)
Steel Plate Beam Guardrail, Type B w/steel posts	30 lb/ft (45 kg/m)
Steel Plate Beam Guardrail, Types A and B w/wood posts	8 lb/ft (12 kg/m)
Steel Plate Beam Guardrail, Type 2	305 lb (140 kg) each
Steel Plate Beam Guardrail, Type 6	1260 lb (570 kg) each
Traffic Barrier Terminal, Type 1 Special (Tangent)	730 lb (330 kg) each
Traffic Barrier Terminal, Type 1 Special (Flared)	410 lb (185 kg) each
Steel Traffic Signal and Light Poles, Towers and Mast Arms	
Traffic Signal Post	11 lb/ft (16 kg/m)
Light Pole, Tenon Mount and Twin Mount, 30 - 40 ft (9 – 12 m)	14 lb/ft (21 kg/m)
Light Pole, Tenon Mount and Twin Mount, 45 - 55 ft (13.5 – 16.5 m)	21 lb/ft (31 kg/m)
Light Pole w/Mast Arm, 30 - 50 ft (9 – 15.2 m)	13 lb/ft (19 kg/m)
Light Pole w/Mast Arm, 55 - 60 ft (16.5 – 18 m)	19 lb/ft (28 kg/m)
Light Tower w/Luminaire Mount, 80 - 110 ft (24 – 33.5 m)	31 lb/ft (46 kg/m)
Light Tower w/Luminaire Mount, 120 - 140 ft (36.5 – 42.5 m)	65 lb/ft (97 kg/m)
Light Tower w/Luminaire Mount, 150 - 160 ft (45.5 – 48.5 m)	80 lb/ft (119 kg/m)
Metal Railings (excluding wire fence)	
Steel Railing, Type SM	64 lb/ft (95 kg/m)
Steel Railing, Type S-1	39 lb/ft (58 kg/m)
Steel Railing, Type T-1	53 lb/ft (79 kg/m)
Steel Bridge Rail	52 lb/ft (77 kg/m)
Frames and Grates	
Frame	250 lb (115 kg)
Lids and Grates	150 lb (70 kg)

SUBCONTRACTOR AND DBE PAYMENT REPORTING (BDE)

Effective: April 2, 2018

Add the following to Section 109 of the Standard Specifications.

"**109.14 Subcontractor and Disadvantaged Business Enterprise Payment Reporting.** The Contractor shall report all payments made to the following parties:

(a) first tier subcontractors;

(b) lower tier subcontractors affecting disadvantaged business enterprise (DBE) goal credit;

(c) material suppliers or trucking firms that are part of the Contractor's submitted DBE utilization plan.

The report shall be made through the Department's on-line subcontractor payment reporting system within 21 days of making the payment."

SUBCONTRACTOR MOBILIZATION PAYMENTS (BDE)

Effective: November 2, 2017
Revised: April 1, 2019

Replace the second paragraph of Article 109.12 of the Standard Specifications with the following:

"This mobilization payment shall be made at least seven days prior to the subcontractor starting work. The amount paid shall be at the following percentage of the amount of the subcontract reported on form BC 260A submitted for the approval of the subcontractor's work.

Value of Subcontract Reported on Form BC 260A	Mobilization Percentage
Less than $10,000	25%
$10,000 to less than $20,000	20%
$20,000 to less than $40,000	18%
$40,000 to less than $60,000	16%
$60,000 to less than $80,000	14%
$80,000 to less than $100,000	12%
$100,000 to less than $250,000	10%
$250,000 to less than $500,000	9%
$500,000 to $750,000	8%
Over $750,000	7%"

SUBMISSION OF PAYROLL RECORDS (BDE)

Effective: April 1, 2021 Revised: November 1, 2022

FEDERAL AID CONTRACTS. Revise the following section of Check Sheet #1 of the Recurring Special Provisions to read:

"STATEMENTS AND PAYROLLS

The payroll records shall include the worker's name, the worker's address, the worker's telephone number when available, the worker's social security number, the worker's classification or classifications, the worker's gross and net wages paid in each pay period, the worker's number of hours worked each day, and the worker's starting and ending times of work each day. However, any Contractor or subcontractor who remits contributions to a fringe benefit fund that is not jointly maintained and jointly governed by one or more employers and one or more labor organization must additionally submit the worker's hourly wage rate, the worker's hourly overtime wage rate, the worker's hourly fringe benefit rates, the name and address of each fringe benefit fund, the plan sponsor of each fringe benefit, if applicable, and the plan administrator of each fringe benefit, if applicable.

The Contractor and each subcontractor shall certify and submit payroll records to the Department each week from the start to the completion of their respective work, except that full

social security numbers shall not be included on weekly submittals. Instead, the payrolls shall include an identification number for each employee (e.g., the last four digits of the employee's social security number). In addition, starting and ending times of work each day may be omitted from the payroll records submitted. The submittals shall be made using LCPtracker Pro software. The software is web-based and can be accessed at https://lcptracker.com/. When there has been no activity during a work week, a payroll record shall still be submitted with the appropriate option ("No Work", "Suspended", or "Complete") selected."

STATE CONTRACTS. Revise Item 3 of Section IV of Check Sheet #5 of the Recurring Special Provisions to read:

"3. Submission of Payroll Records. The Contractor and each subcontractor shall, no later than the 15th day of each calendar month, file a certified payroll for the immediately preceding month to the Illinois Department of Labor (IDOL) through the Illinois Prevailing Wage Portal in compliance with the State Prevailing Wage Act (820 ILCS 130). The portal can be found on the IDOL website at https://www2.illinois.gov/idol/Laws-Rules/CONMED/Pages/Prevailing-Wage-Portal.aspx. Payrolls shall be submitted in the format prescribed by the IDOL.

In addition to filing certified payroll(s) with the IDOL, the Contractor and each subcontractor shall certify and submit payroll records to the Department each week from the start to the completion of their respective work, except that full social security numbers shall not be included on weekly submittals. Instead, the payrolls shall include an identification number for each employee (e.g., the last four digits of the employee's social security number). In addition, starting and ending times of work each day may be omitted from the payroll records submitted. The submittals shall be made using LCPtracker Pro software. The software is web-based and can be accessed at https://lcptracker.com/. When there has been no activity during a work week, a payroll record shall still be submitted with the appropriate option ("No Work", "Suspended", or "Complete") selected."

TRAFFIC SPOTTERS (BDE)

Effective: January 1, 2019

Revise Article 701.13 of the Standard Specifications to read:

"**701.13 Flaggers and Spotters.** Flaggers shall be certified by an agency approved by the Department. While on the job site, each flagger shall have in his/her possession a current driver's license and a current flagger certification I.D. card. For non-drivers, the Illinois Identification Card issued by the Secretary of State will meet the requirement for a current driver's license. This certification requirement may be waived by the Engineer for emergency situations that arise due to actions beyond the Contractor's control where flagging is needed to maintain safe traffic control on a temporary basis. Spotters are defined as certified flaggers that provide support to workers by monitoring traffic.

Flaggers and spotters shall be stationed to the satisfaction of the Engineer and be equipped with a fluorescent orange, fluorescent yellow/green, or a combination of fluorescent orange and fluorescent yellow/green vest meeting the requirements of ANSI/ISEA 107-2004 or ANSI/ISEA 107-2010 for Conspicuity Class 2 garments. Flaggers shall be equipped with a stop/slow traffic

control sign. Spotters shall be equipped with a loud warning device. The warning sound shall be identifiable by workers so they can take evasive action when necessary. Other types of garments may be substituted for the vest as long as the garments have a manufacturer's tag identifying them as meeting the ANSI Class 2 requirement. The longitudinal placement of the flagger may be increased up to 100 ft (30 m) from that shown on the plans to improve the visibility of the flagger. Flaggers shall not encroach on the open lane of traffic unless traffic has been stopped. Spotters shall not encroach on the open lane of traffic, nor interact with or control the flow of traffic.

For nighttime flagging, flaggers shall be illuminated by an overhead light source providing a minimum vertical illuminance of 10 fc (108 lux) measured 1 ft (300 mm) out from the flagger's chest. The bottom of any luminaire shall be a minimum of 10 ft (3 m) above the pavement. Luminaire(s) shall be shielded to minimize glare to approaching traffic and trespass light to adjoining properties. Nighttime flaggers shall be equipped with fluorescent orange or fluorescent orange and fluorescent yellow/green apparel meeting the requirements of ANSI/ISEA 107-2004 or ANSI/ISEA 107-2010 for Conspicuity Class 3 garments.

Flaggers and spotters shall be provided per the traffic control plan and as follows.

(a) Two-Lane Highways. Two flaggers will be required for each separate operation where two-way traffic is maintained over one lane of pavement. Work operations controlled by flaggers shall be no more than 1 mile (1600 m) in length. Flaggers shall be in sight of each other or in direct communication at all times. Direct communication shall be obtained by using portable two-way radios or walkie-talkies.

The Engineer will determine when a side road or entrance shall be closed to traffic. A flagger will be required at each side road or entrance remaining open to traffic within the operation where two-way traffic is maintained on one lane of pavement. The flagger shall be positioned as shown on the plans or as directed by the Engineer.

(b) Multi-Lane Highways. At all times where traffic is restricted to less than the normal number of lanes on a multilane pavement with a posted speed limit greater than 40 mph and the workers are present, but not separated from the traffic by physical barriers, a flagger or spotter shall be furnished as shown on the plans. Flaggers shall warn and direct traffic. Spotters shall monitor traffic conditions and warn workers of errant approaching vehicles or other hazardous conditions as they occur. One flagger will be required for each separate activity of an operation that requires frequent encroachment in a lane open to traffic. One spotter will be required for each separate activity with workers near the edge of the open lane or with their backs facing traffic.

Flaggers will not be required when no work is being performed, unless there is a lane closure on two-lane, two-way pavement."

VEHICLE AND EQUIPMENT WARNING LIGHTS (BDE)

Effective: November 1, 2021
Revised: November 1, 2022

Add the following paragraph after the first paragraph of Article 701.08 of the Standard Specifications:

"The Contractor shall equip all vehicles and equipment with high-intensity oscillating, rotating, or flashing, amber or amber-and-white, warning lights which are visible from all directions. In accordance with 625 ILCS 5/12-215, the lights may only be in operation while the vehicle or equipment is engaged in construction operations."

WEEKLY DBE TRUCKING REPORTS (BDE)

Effective: June 2, 2012 Revised: November 1, 2021

The Contractor shall submit a weekly report of Disadvantaged Business Enterprise (DBE) trucks hired by the Contractor or subcontractors (i.e. not owned by the Contractor or subcontractors) that are used for DBE goal credit.

The report shall be submitted to the Engineer on Department form "SBE 723" within ten business days following the reporting period. The reporting period shall be Sunday through Saturday for each week reportable trucking activities occur.

Any costs associated with providing weekly DBE trucking reports shall be considered as included in the contract unit prices bid for the various items of work involved and no additional compensation will be allowed.

WORK ZONE TRAFFIC CONTROL DEVICES (BDE)

Effective: March 2, 2020

Add the following to Article 701.03 of the Standard Specifications:

"(q) Temporary Sign Supports ..... 1106.02"

Revise the third paragraph of Article 701.14 of the Standard Specifications to read:

"For temporary sign supports, the Contractor shall provide a FHWA eligibility letter for each device used on the contract. The letter shall provide information for the set-up and use of the device as well as a detailed drawing of the device. The signs shall be supported within 20 degrees

of vertical. Weights used to stabilize signs shall be attached to the sign support per the manufacturer's specifications."

Revise the first paragraph of Article 701.15 of the Standard Specifications to read:

"**701.15 Traffic Control Devices.** For devices that must meet crashworthiness standards, the Contractor shall provide a manufacturer's self-certification or a FHWA eligibility letter for each Category 1 device and a FHWA eligibility letter for each Category 2 and Category 3 device used on the contract. The self-certification or letter shall provide information for the set-up and use of the device as well as a detailed drawing of the device."

Revise the first six paragraphs of Article 1106.02 of the Standard Specifications to read:

"**1106.02 Devices.** Work zone traffic control devices and combinations of devices shall meet crashworthiness standards for their respective categories. The categories are as follows.

Category 1 includes small, lightweight, channelizing and delineating devices that have been in common use for many years and are known to be crashworthy by crash testing of similar devices or years of demonstrable safe performance. These include cones, tubular markers, plastic drums, and delineators, with no attachments (e.g. lights). Category 1 devices manufactured after December 31, 2019 shall be MASH-16 compliant. Category 1 devices manufactured on or before December 31, 2019, and compliant with NCHRP 350 or MASH 2009, may be used on contracts let before December 31, 2024.

Category 2 includes devices that are not expected to produce significant vehicular velocity change but may otherwise be hazardous. These include vertical panels with lights, barricades, temporary sign supports, and Category 1 devices with attachments (e.g. drums with lights). Category 2 devices manufactured after December 31, 2019 shall be MASH-16 compliant. Category 2 devices manufactured on or before December 31, 2019, and compliant with NCHRP 350 or MASH 2009, may be used on contracts let before December 31, 2024.

Category 3 includes devices that are expected to cause significant velocity changes or other potentially harmful reactions to impacting vehicles. These include crash cushions (impact attenuators), truck mounted attenuators, and other devices not meeting the definitions of Category 1 or 2. Category 3 devices manufactured after December 31, 2019 shall be MASH-16 compliant. Category 3 devices manufactured on or before December 31, 2019, and compliant with NCHRP 350 or MASH 2009, may be used on contracts let before December 31, 2029. Category 3 devices shall be crash tested for Test Level 3 or the test level specified.

Category 4 includes portable or trailer-mounted devices such as arrow boards, changeable message signs, temporary traffic signals, and area lighting supports. It is preferable for Category 4 devices manufactured after December 31, 2019 to be MASH-16 compliant; however, there are currently no crash tested devices in this category, so it remains exempt from the NCHRP 350 or MASH compliance requirement.

For each type of device, when no more than one MASH-16 compliant is available, an NCHRP 350 or MASH-2009 compliant device may be used, even if manufactured after December 31, 2019."

Revise Articles 1106.02(g), 1106.02(k), and 1106.02(l) to read:

"(g) Truck Mounted/Trailer Mounted Attenuators. The attenuator shall be approved for use at Test Level 3. Test Level 2 may be used for normal posted speeds less than or equal to 45 mph.

(k) Temporary Water Filled Barrier. The water filled barrier shall be a lightweight plastic shell designed to accept water ballast and be on the Department's qualified product list.

Shop drawings shall be furnished by the manufacturer and shall indicate the deflection of the barrier as determined by acceptance testing; the configuration of the barrier in that test; and the vehicle weight, velocity, and angle of impact of the deflection test. The Engineer shall be provided one copy of the shop drawings.

(l) Movable Traffic Barrier. The movable traffic barrier shall be on the Department's qualified product list.

Shop drawings shall be furnished by the manufacturer and shall indicate the deflection of the barrier as determined by acceptance testing; the configuration of the barrier in that test; and the vehicle weight, velocity, and angle of impact of the deflection test. The Engineer shall be provided one copy of the shop drawings. The barrier shall be capable of being moved on and off the roadway on a daily basis."

WORKING DAYS (BDE)

Effective: January 1, 2002

The Contractor shall complete the work within **90** working days.

REVISIONS TO THE ILLINOIS PREVAILING WAGE RATES

The Prevailing rates of wages are included in the Contract proposals which are subject to Check Sheet #5 of the Supplemental Specifications and Recurring Special Provisions. The rates have been ascertained and certified by the Illinois Department of Labor for the locality in which the work is to be performed and for each craft or type of work or mechanic needed to execute the work of the Contract. As required by Prevailing Wage Act (820 ILCS 130/0.01, et seq.) and Check Sheet #5 of the Contract, not less than the rates of wages ascertained by the Illinois Department of Labor and as revised during the performance of a Contract shall be paid to all laborers, workers and mechanics performing work under the Contract. Post the scale of wages in a prominent and easily accessible place at the site of work.

If the Illinois Department of Labor revises the prevailing rates of wages to be paid as listed in the specification of rates, the contractor shall post the revised rates of wages and shall pay not less than the revised rates of wages. Current wage rate information shall be obtained by visiting the Illinois Department of Labor web site at http://www.state.il.us/agency/idol/ or by calling 312-793-2814. It is the responsibility of the contractor to review the rates applicable to the work of the contract at regular intervals in order to insure the timely payment of current rates. Provision of this information to the contractor by means of the Illinois Department of Labor web site satisfies the notification of revisions by the Department to the contractor pursuant to the Act, and the contractor agrees that no additional notice is required. The contractor shall notify each of its subcontractors of the revised rates of wages.