TECHNICAL SPECIFICATIONS
FOR THE
LITTLE RIVER BAND OF OTTAWA INDIANS
HEADWORKS ADDITION

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SECTION 01 11 00

SUMMARY OF WORK

PART 1 GENERAL

1.01 WORK COVERED BY CONTRACT DOCUMENTS

A. General:
1. The work involves the construction of a new headworks building as an addition to the existing wastewater treatment plant for the Little River Band of Ottawa Indians.

2. The work includes, but is not limited to, the major items described below:
   a. Sitework and Yard Piping:
      1. Site grading cut and fill for new building.
      2. Access drive
      3. Underground process piping, water piping, and site utilities.
      4. Influent sewer and associated structures.
      5. Restoration of all disturbed surfaces.
      6. Utilities for new facilities.
      7. Maintain existing facilities until the new plant is approved and operational.

   b. Headworks Building
      1. Concrete block, footings and concrete floor, wood truss roof building to house new equipment.
      2. Mechanical screen equipment.
      3. Mechanical Piping, HVAC, power and electrical wiring, gas detection, and associated instrumentation.

   c. Electrical Systems
      1. Building and site lighting and power distribution.

   d. Instrumentation
      1. Main control panel.
      2. Process controls and control panels.

1.02 CONTRACTS

All work will be awarded under a single contract.

1.03 ALTERNATES

No alternates are considered as part of this project.

1.04 WORK BY OTHERS

A. Site is an operational wastewater treatment facility. Contractor shall coordinate their work with the wastewater operators and disruptions should be minimized.

1.05 FUTURE WORK

No future work is anticipated that will affect work under this project.

1.06 WORK SEQUENCE

A. Submit sequence of work plan to the Engineer for review.

1.07 COORDINATION

A. Coordinate all work with the Owner to minimize any inconvenience.

1.08 AVAILABILITY OF LANDS
All work will take place on property owned by LRBOI, within the public right-of-way or within easements granted to LRBOI.

1.09 PRE-ORDERED/PRE-BID ITEMS
No items have been pre-ordered for this project.

1.10 OWNER FURNISHED ITEMS
No items will be furnished by the owner for this project.

1.11 PROJECT IDENTIFICATION AND SIGNS
A project sign will not be required for this project.

1.12 AUDIO-VIDEO ROUTE SURVEY
An A-V Route Survey will not be required.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 01 20 00
PRICE AND PAYMENT PRODCEDURE

PART 1 GENERAL

1.01 SUMMARY

A. Refer to Article 15 of the General Conditions.

B. Bid price includes all labor, tools, equipment, materials, transportation, allowances and applicable fees and sales tax necessary to complete the work in accordance with the Plans and Specifications.

C. All payments will be based on completed work, ready for use, performed in strict accordance with the Plans and Specifications.

D. Bid quantities listed in the Bid Schedule have been estimated and are only for the purpose of comparing, on a uniform basis, the Bids offered for the Work. Completed quantities for payment will be based on field measurements.

E. Neither the Owner nor his agents shall be held responsible should any of the estimated quantities be found incorrect.

F. Payment will be made only on items listed in the BID SCHEDULE. All other work not listed in the BID SCHEDULE shall be considered incidental to the performance of the Work.

G. Owner reserves the right to delete any line item or quantity on the BID SCHEDULE.

1.02 APPLICATION FOR PAYMENT

A. Pay period: 30 days.

B. Payment requests shall be submitted on the forms included in the Specifications.

1.03 SUBMITTALS

A. Submit Conditional Partial Waiver of Lien with each application for payment request, as specified in the General Conditions paragraph 15.01.B.

B. Submit a schedule of values in accordance with Section 01 33 00 for all Lump Sum Bids items. Payments will be based on work completed within the schedule of values.

C. Prior to the first partial payment, submit a construction progress schedule in accordance with Paragraph 2.05 of the General Conditions.

1.04 ITEMS OF THE BID FORM

A. Items No. 1 - Wastewater Headworks Addition – Complete and Operational (as defined in Plans and Technical Specifications)

1. Payment includes all demolition, earth moving, excavation, compaction and backfilling, restoration, complete construction of the Headworks Building, all Equipment, all site piping,

manholes and site structures, by-pass pumping, building piping and plumbing, mechanical and HVAC equipment, all electrical equipment, conduit and wiring and all equipment as shown on the project plans complete and operational as specified and/or intended.

Unit of Measure: Lump sum

END OF SECTION

SECTION 01 25 00

SUBSTITUTION PROCEDURES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes substitution of materials, articles, and equipment.

B. Recommend substitutions in accordance with this section and Section 7.05 of the General Conditions.

C. Products of equal capacities, quality and function shall be considered.

PART 2 PRODUCTS

2.01 GENERAL

A. Submit a digital copy of a complete list of all products proposed for installation within 30 days after date of Contract, unless otherwise indicated in the Contract Documents.

B. Tabulate the list by each Specification Section.

C. Include the following for referenced products:
1. Name and address of manufacturer.
2. Trade name.
3. Model or catalog designation.
4. Manufacturer’s data including performance and test data, and reference standards.

PART 3 EXECUTION

3.01 CONTRACTOR’S OPTIONS

A. For products specified by reference, select any product meeting the standards.

B. Submit a request for substitution for products specified by name.

3.02 GENERAL

A. Written requests from Bidders will only be considered if received at least ten working days prior to Bid date.

B. The Engineer will consider formal requests from the Contractor for substitution of specified products within thirty days of Contract unless specified elsewhere in the Contract Documents.

C. Submit a digital copy of all substitution requests.

D. Substitutions will not be considered if:
1. Indicated or implied on Shop Drawings or project data submittals without formal request submitted in accordance with this Section and Section 7.05 of the General Conditions.

2. Acceptance will require substantial revision of the Contract Documents.

3.03 SUBMITTALS

A. Complete data substantiating compliance with the Contract Documents.

B. For products:
   1. Product identification, including manufacturer's name and address.
   2. Manufacturer's literature, including product description, performance and test data, and reference standards.
   3. Samples.
   4. Name and address of similar projects on which the product was used and date of installation.
   5. Detailed drawings for modifications to other aspects of the project required for the substitution in accordance with Section 7.05.A.3 of the General Conditions.

C. For construction methods:
   1. Detailed description of the proposed method.
   2. Drawings illustrating methods.

3.04 CONTRACTOR'S RESPONSIBILITIES

A. Investigate the proposed product or method and determine that it is equal or superior in all respects to that which is specified.

B. Provide the same guarantee for the substitution as for the product or method specified.

C. Coordinate installation of the accepted substitution into the work, making changes as required for the work to be completed in all respects.

D. Waive all claims for additional costs related to the substitution.

E. Include itemized cost estimate in accordance with Section 7.05.1.b of the General Conditions.

END OF SECTION

SECTION 01 31 13

PROJECT MEETINGS

PART 1 GENERAL

1.01 PRECONSTRUCTION MEETING

A. Prior to delivery of materials or the start of any construction a preconstruction meeting will be held.

B. The Engineer will establish the meeting place, time and date, distribute agenda, notify participants, and administer the meeting. Contractor shall notify major subcontractors.

C. Attendance:
1. OWNER
2. ENGINEER
3. CONTRACTOR
4. Major Subcontractors
5. Utility Companies
6. Safety Representatives
7. Governmental Agencies

D. Agenda:
1. Distribution by Contractor and discussion of:
   a. List of names and telephone numbers for superintendent, foreman and other key personnel.
   b. List of major subcontractors and suppliers.
   c. Projected Construction Schedules.
2. Critical work sequencing.
3. Major equipment deliveries and priorities.
4. Project coordination
5. Responsibilities of Owner, Engineer, Contractor and other agencies.
6. Utility Discussions
   a. Critical Utilities
7. Permit Issues
8. Procedures and processing of:
   a. Field decisions.
   b. Proposal requests.
   c. Submittals.
   d. Change orders.
   e. Application for payment.
9. Adequacy of distribution of Contract Documents.
10. Procedures for maintaining Record Documents.
11. Use of premises.
12. Construction facilities, controls and construction aids.
13. Temporary utilities.
14. Safety and first aid procedures.
15. Security procedures.
16. Housekeeping procedures.
17. Testing and Staking
18. Record Documents
19. Sign Contracts

E. The Engineer will prepare minutes and distribute copies to participants within seven (7) days of meeting. Participants shall report corrections and comments within ten (10) days of receipt of minutes.

1.02 PROGRESS MEETINGS

A. Periodic Progress Meetings will be held as required by the progress of the work.

B. The Engineer will establish the meeting place, time and date, distribute agenda, notify participants and administer the meeting. Contractor shall notify major subcontractors.

C. Attendance:
1. OWNER
2. ENGINEER
3. CONTRACTOR
4. Subcontractor as appropriate to the agenda.
5. Suppliers as appropriate to the agenda.
6. Others

D. Agenda:
1. Review minutes of previous meeting.
2. Review of work progress since previous meeting.
3. Review field observations, problems, and conflicts.
4. Review problems that impede Construction Schedules.
5. Review of shop drawings, off-site fabrication, and delivery schedules.
6. Review corrective measures and procedures to regain projected schedule.
7. Review revisions to Construction Schedules.
8. Review plan progress, schedule, during succeeding work period.
9. Review coordination of schedules.
10. Review submittal schedules; expedite as required.
11. Review maintenance of quality standards.
12. Review proposed changes for:
    a. Effect on Construction Schedule and on completion date.
    b. Effect on other Contracts of the Project.
13. Other business.

E. The Engineer will prepare minutes and distribute copies to participants and Owner within seven (7) days of meeting for review at the next meeting.

PART 2 PRODUCT - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 GENERAL

1.01 CONSTRUCTION SCHEDULE

A. Preparation:
1. Prepare in the form of a horizontal bar chart, CPM network, or other form previously approved by the Engineer.
2. Provide a separate horizontal bar column or path for each trade or operation.
3. Prepare the schedule in the chronological order of the beginning of each item of work.
4. Allow space for updating.
5. The schedule sheets shall be 11" x 17" unless otherwise approved by the Engineer.

B. Content of schedule:
1. Provide a complete sequence of construction by activity.
2. For Shop Drawings, project data, and samples show the following:
   a. Submittal dates.
   b. Dates review copies will be required.
3. Show product procurement and delivery dates.
4. Show dates for beginning and completion of each element of construction.
5. Show projected percentage of completion for each item of work as of the first day of each month.

C. Updating Schedule:
1. Show all changes occurring since previous submission of the updated schedule.
2. Indicate progress of each activity and show completion dates.
3. Other items required in schedule updates are:
   a. Major changes in scope.
   b. Activities modified since previous updating.
   c. Revised projections due to changes
   d. Other identifiable changes.

D. Submittals:
1. Submit initial schedule within 15 days after receipt of a Notice to Proceed.
2. Submit updated schedules accurately depicting progress to the first day of each month.
3. Progress schedules shall be included with the Contractor’s monthly application for payment

1.02 APPLICATION FOR PAYMENT

A. Preparation:
1. Applications for payment to be submitted in accordance with Article 15 of the General Conditions.
2. Application for payment shall be made on forms provided by or approved by the Engineer.

B. Schedule of Values:
1. Contractor shall submit a schedule of values for all lump sum items in the Bid Schedule.
2. A preliminary schedule of values shall be submitted to the Engineer for review and approval prior to the pre-construction meeting.
3. Schedule of values will be used only as the basis for the Contractor’s application for payment.

C. Submittals
   1. Contractor shall submit electronic copies to the Engineer for review.
   2. Application for payment shall be submitted to the Engineer as agreed to at the pre-construction meeting.

1.03 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

A. General:
   1. Provide shop drawings in accordance with Article 7 of the General Conditions.
   2. Shop Drawings are to be scaled drawings large enough to show all pertinent features of the item and its method of connection to the Work.
   3. Literature from manufacturers that includes data not pertinent to this submittal, shall be clearly marked to indicate which portion of the contents is being submitted for the Engineer's review.
   4. Samples shall illustrate materials, equipment, or workmanship and establish standards by which completed work is judged.
   5. Unless otherwise specifically directed by the Engineer, all samples shall be of the precise article proposed to be furnished.
   6. Manufacturers must submit the certification of compliance with AIS (RUS Bulletin 1726, Exhibit A, Attachment 5) found in the bid documents, with shop drawings.

B. Submittals:
   1. Submit the shop drawings electronically via an electronic shared folder set up by Engineer. When not possible to submit drawings electronically, submit the number of copies that the Contractor requires to be returned, plus two copies that will be retained by the Engineer.
   2. All submittals are to be accompanied with a transmittal form that will be provided by or approved by the Engineer.
   3. Contractor to thoroughly check Shop Drawings for compliance with the Contract Documents and verify field dimensions and construction criteria:
      a. Indicate approval by stamping "Approved", with Contractors signature and date on all copies submitted.
      b. Shop Drawings submitted without stamped approval of the Contractor will be returned without review.
   4. Clearly indicate all deviations in the Shop Drawings from the requirements in the Contract Documents.
   5. Make submittals in groups containing all associated items.
   6. Provide submittals in advance of scheduled dates of installation to allow time for Engineer review, possible revision, and re-submittal; and for placing orders and securing delivery.
   7. Allow 15 working days for Engineer review after receipt of submittal.
   8. Cost of delays caused by late submittals shall be the responsibility of the Contractor.

C. Review of submittals:
   1. Submittals will be returned marked with Engineer’s review comments.
   2. Rejected submittals shall be revised by the Contractor and resubmitted.
   3. Engineer's checking of Shop Drawings does not relieve the Contractor of responsibility for errors or omissions.

1.04 OPERATION AND MAINTENANCE MANUALS

A. General:
   1. Manuals shall be in durable plastic binders approximately 8½ " x 11" in size with at least the following:

a. Identification on or readable through, the front cover stating general nature of the manual;
b. Neatly typewritten index near the front of the manual;
c. Complete instructions regarding operation and maintenance of all equipment involved;
d. Complete nomenclature of all replaceable parts, their part numbers, and name and address of nearest vendor of parts;
e. Copies of all guarantees and warranties issued;
f. Copy of the approved Shop Drawing and all data concerning all changes made during construction.

2. Manuals that include manufacturer's catalog pages shall clearly indicate the precise items included in this installation and delete or otherwise clearly indicate all manufacturers' data with which this installation is not concerned.
3. One Electronic Manual on a compact disc or USB thumb drive, clearly labeled, shall be submitted.

B. Submittals:
1. Provide one (1) paper copy and one (1) electronic copy of the manual to the Engineer unless indicated otherwise in pertinent Sections.
2. Submit operation and maintenance manuals prior to initial equipment startup.

PART 2 PRODUCT - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 01 41 00

REGULATORY REQUIREMENTS

PART 1 GENERAL

1.01 PERMITS AND FEES

A. Owners responsibility: The owner will obtain the following permits where applicable.
   1. EGLE permit in accordance with Part 41 of Act 451, P.A. 1994 for construction of sanitary sewer facilities.
   2. MDOT permit for work within state right-of-way.
   3. Soil Erosion and Sedimentation Control Act, Part 91 of Act 451, P.A. 1994.
   4. EGLE Wetland permit in accordance with Part 303 of Act 451, P.A. 1994.
   5. EGLE Inland Lakes and Streams permit in accordance with Part 301 of Act 451, P.A. 1994.
   6. FAA approval for work within applicable distance from the Airport.

B. Contractors responsibility:
   1. Meet provisions and requirements of all permits obtained by the Owner.
   2. All local or state permits and fees required that are not listed in Section 01 41 00 1.01.A.
   3. If applicable, contractor shall get bonding for construction within state highway right-of-way.
   4. Provide additional construction information (use and location of crane) for FAA to finalize the study on construction within airport property.

C. All permits obtained to date are attached at the end of the specifications.

1.02 APPLICABLE CODES

A. All references to codes, specifications, and standards shall refer to the latest edition, amendment, or revision of the reference in effect on the BID due date.

B. Abbreviations used for codes and references are listed in Section 01 42 13 ABBREVIATIONS AND ACRONYMS.

PART 2 PRODUCT - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 01 42 13

ABBREVIATIONS AND ACRONYMS

PART 1 GENERAL

1.01 DEFINITIONS

A. Reference to codes, standards, institutions, associations, or government authorities is made in accordance with the following abbreviations:

AASHTO	- American Association of State Highway Officials
ACI	- American Concrete Institute
AISC	- American Institute of Steel Construction
AISI	- American Iron and Steel Institute
ANSI	- American National Standard Institute
ASTM	- American Society of Testing Materials
AWS	- American Welding Society
AWWA	- American Water Works Association
BOCA	- Building Officials Code Association
EGLE	- Michigan Department of Environment, Great Lakes, and Energy
FAA	- Federal Aviation Association
MDOT	- Michigan Department of Transportation
MDNR	- Michigan Department of Natural Resources
MI-OSHA	- Michigan Department of Occupational Safety and Health Association
NEC	- National Electric Code
NEMA	- National Electrical Manufacturers Association
NFPA	- National Fire Protection Association
RECD	- Rural Economic Community Development
USEPA	- United States Environmental Protection Agency
UL	- Underwriter’s Laboratories

PART 2 PRODUCT - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 01 45 29

TESTING LABORATORY SERVICES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes, testing required by the Owner to determine that materials and methods provided for the Work meet the specified requirements. Testing includes, but is not limited to:
   1. Bituminous pavement.
   2. Concrete.
   3. Soil Gradation.
   4. Welding.
   5. Pressure testing.
   6. Density Testing.

1.02 UNIT PRICES

A. The Contractor will be responsible for providing and paying for all testing procedures as described in Article 14 of General Conditions unless specified in this section.

B. The Contractor will be responsible for selecting proper testing laboratories subject to Engineer's approval.

C. Inspections and testing performed exclusively for the Contractors convenience will be paid for by the Contractor.

D. The Owner will select the testing laboratories and pay for the following tests/inspections:
   1. Density testing
   2. Density and extraction testing of asphalt
   3. Grading of subbase and aggregate base
   4. Concrete testing

1.03 QUALITY ASSURANCE

A. Testing shall be in accordance with all pertinent codes, regulations, procedures, and requirements of the ASTM and other appropriate agencies.

PART 2 PRODUCTS -Not Used

PART 3 EXECUTION

3.01 PROCEDURE

A. Provide representatives of the testing laboratory with access to the Work at all times.

B. Coordinate the Work with the testing required. Provide a minimum of 24 hours notice to the testing laboratory prior to the need of testing.

C. Furnish all material required for sampling. The testing laboratory will obtain all specimens and samples required for testing. The testing laboratory will be responsible for transporting samples to the laboratory.

D. The testing laboratory will furnish one copy of lab report to the Engineer. The Contractor can request a copy from the Engineer.

END OF SECTION

SECTION 01 51 00

TEMPORARY UTILITIES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes providing temporary utilities.

B. Maintain all temporary facilities in proper and safe condition.

C. Provide and pay all costs for all water, sanitary, electricity, heat, garbage disposal and telephone utilities necessary for the performance of the work.

D. Remove all temporary utilities at the close of the project.

PART 2 PRODUCTS

2.01 GENERAL

A. Materials must be adequate in capacity, must be safe, and must not violate requirements of applicable codes and standards.

2.02 SANITARY FACILITIES

A. Furnish, install, and maintain temporary sanitary facilities for employees use.

B. Comply with State and local health department rules and regulations, and all requirements of the Michigan Department of Labor Construction Safety Commission Standards.

2.03 WATER, ELECTRICITY, AND TELEPHONE

A. The contractor will make their own arrangements for temporary service of these utilities.

B. The contractor will be responsible for all costs associated with these utilities.

2.04 TEMPORARY HEATING

A. Provide temporary heat and ventilation necessary to maintain environmental conditions to facilitate work progress and meet the minimum conditions for the installation of materials, and to protect materials and finishes from damage due to temperature or humidity.

B. The contractor will be responsible for all costs associated with temporary heating and ventilation.

PART 3 EXECUTION

3.01 GENERAL

A. Maintain and operate systems to assure continuous service. Modify and extend systems as work progress requires.

B. Completely remove temporary materials when they are no longer being used.

END OF SECTION

SECTION 01 52 13

FIELD OFFICE

PART 1 GENERAL

1.01 SUMMARY

Furnish and install on the site, a field office for the Contractor and the Engineer.

1.02 CONTRACTORS FIELD OFFICE:

A. Provide enclosed structure with Wi-Fi hotspot.

B. Pay for all heat, electricity, and necessary utilities.

1.03 ENGINEERS FIELD OFFICE:

A. The Engineer's field office may be either separate from the Contractor's field office or, share the same structure as the Contractor's field office.

B. The doors shall have locks, with two keys supplied to the Engineer.

C. Furnish the following equipment and utilities:
1. Sloping plan desk
2. Normal office desk, approximately 3' x 5'
3. One desk chair
4. Adequate shelving for storage of books, drawings, and the like
5. At least one letter size file cabinet
6. One straight chair
7. Utilities including heat and lights
8. Wi-Fi

D. Pay for all heat, electricity and wireless internet.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 01 55 26

TRAFFIC CONTROL

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Provide and maintain traffic control equipment and personnel to protect the work and workmen, and to ensure the least possible obstruction to traffic and inconvenience to the general public.
   2. Meet all the requirements of the construction permit issued by the right-of-way owner.

B. Related Sections:
   Section 01 20 00 – PRICE AND PAYMENT PROCEDURE

1.02 UNIT PRICES

All work under this Section shall be considered as incidental to construction, unless specifically indicated on the BID SCHEDULE and referred to in Section 01 20 00 – PRICE AND PAYMENT PROCEDURE.

1.03 REFERENCED STANDARDS

MDOT Michigan Manual of Uniform Traffic Control Devices (MMUTCD)

PART 2 PRODUCTS

2.01 GENERAL

All products shall be in accordance with the Michigan Manual of Uniform Traffic Control Devices.

PART 3 EXECUTION

3.01 DETOURS

A. Contractor shall be solely responsible for acts or omissions resulting in any legal proceedings due to improper or inadequate detour or safety controls.

B. Submit proposed detour route to the Engineer, the municipality, and all emergency services for approval prior to construction in the detour area.

C. Keep fire hydrants adjacent to the work accessible to fire fighting equipment at all times.

D. Keep police, fire, and other emergency services informed of the status of road closings.

3.02 PUBLIC ACCESS

A. Maintain traffic access in accordance with local laws and regulations having jurisdiction.

B. Minimize the time that vehicular and pedestrian access to any occupied home, or other building

is interrupted. Maintain continuous access to businesses.

C. Maintain temporary driveways, roadways, and crosswalks in good, usable condition until they are fully restored. As a minimum, provide 6 inches of compacted 4-G aggregate at all driveways.

END OF SECTION

SECTION 01 56 00

TEMPORARY BARRIERS AND ENCLOSURES

PART 1 GENERAL

1.01 SUMMARY

A. Provide and maintain adequate facilities for the protection and safety of all persons and property in accordance with Article 7 of General Conditions.

1.02 UNIT PRICES

A. All work under this Section shall be considered as incidental to construction.

1.03 REFERENCED STANDARDS

A. Unless otherwise specified, the work for this Section shall conform to all State and National laws, ordinances, rules and regulations pertaining to the kind, including but not limited to the following Standard Specifications:
   1. State of Michigan "Occupational Safety and Health Act", Act 154 of the Public Acts of 1974 (MIOSHA) as administered by the Michigan Department of Labor and Public Health.
   2. MDOT Michigan Manual of Uniform Traffic Control Devices (MMUTCD)

PART 2 PRODUCTS

2.01 SIGNS AND BARRICADES

A. Provide in accordance with MDOT Michigan Manual of Uniform Traffic Control Devices - Part 6.

2.02 TEMPORARY FENCING

A. All fencing shall be strong and durable enough to discourage unauthorized entrance, constructed with the following materials:
   1. Posts: Wood or steel
   2. Fabric: Snow fence type, wood or plastic, 4 feet high.

PART 3 EXECUTION

3.01 GENERAL

A. Provide adequate warning signs, barricades, lights, and flagmen as necessary for the protection of the work and safety of the workmen and general public. Control devices shall:
   1. Protect workmen and the public from all open trenches and excavations.
   2. Provide temporary fencing to discourage unauthorized entrance.

B. All barricades, signs, lights, and other protective devices shall be installed and maintained in conformance with the transportation authority having jurisdiction.

C. Designate all streets or roads that are closed with barricades and warning signs. Closing of roads shall be approved by the authority having jurisdiction. Properly notify the local emergency services prior to closing of any road.

D. Maintain temporary fencing throughout the duration of construction.

E. Remove temporary fencing at project completion or after permanent fencing is installed.

END OF SECTION

SECTION 01 58 00

PROJECT SIGN

PART 1 GENERAL

1.01 SUMMARY

A. Furnish and erect project sign(s) at a prominent location(s) approved by the Engineer.

B. The sign, materials, and lettering shall conform to the requirements shown in the Figure at the end of this section.

C. Maintain the project sign in good repair throughout the project.

D. Remove the project sign at project completion.

E. No other signs shall be displayed at the project site without prior Engineer approval.

END OF SECTION

SECTION 01 66 00

PRODUCT STORAGE AND HANDLING REQUIREMENTS

PART 1 GENERAL

1.01 SUMMARY

A. Furnish all labor, tools, facilities, and materials necessary to properly transport, handle, store and protect all materials and equipment necessary for the performance of the work.

B. All materials shall be new.

C. Immediately upon delivery, inspect shipments to assure compliance with requirements of Contract Documents and approved submittals and that products are properly protected and undamaged.

1.02 TRANSPORTATION AND HANDLING

A. Properly protect all materials and equipment to prevent damage during transportation and handling.

B. Detailed special handling requirements are specified under the appropriate specification section for the products handled.

1.03 STORAGE AND PROTECTION

A. Store all materials and equipment to insure the preservation of their quality and fitness for the work.

B. Store packaged materials in their original containers until ready for use.

C. Protect all materials and equipment before, during, and after installation.

D. Provide suitable weather tight storage sheds with raised floors to store and protect materials and equipment that could be damaged by exposure to weather.

E. Repair or replace all damaged materials and equipment, subject to Engineer approval.

F. No damaged material shall be used in the work.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 01 75 16

STARTUP PROCEDURES

PART 1 GENERAL

1.01 TEST OPERATION AND RUN-IN:

A. Notify the Engineer and test operate the equipment to the Engineer's satisfaction.

B Test operate all equipment including controls and associated items, after completion of the electrical and mechanical work.

C. Run-in and make ready for operation all equipment after test operations.

D. "Run-in" shall mean sufficient operation to wear in gears, motors, bearings, and any other items in accordance with the manufacturer's recommendations.

E. "Ready for operation" shall mean fully aligned, tested under full load, adjusted, cleaned, and ready for use.

F. "Completely installed" shall mean that the installation is complete and ready for final payment.

1.02 FIELD SERVICES:

A. Secure the services of a qualified equipment manufacturer representative to assist in erection, inspection, make necessary adjustments, initiate the start-up, and resolve start-up problems.

B. Provide a qualified equipment manufacturer’s representative for instruction of Owner's personnel in the proper operation and maintenance of the equipment.

C. Coordinate the training of personnel through the Engineer after test operation and run in.

D. Furnish written reports from the equipment manufacturer for each visit. The report shall contain the findings, recommendations, and any pertinent comments, with a signature and title of the representative. At least one (1) paper copy and one (1) digital copy of the report shall be furnished to the Engineer.

PART 2 PRODUCT - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 01 78 00

CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes contract close-out requirements.

B. Contract close-out shall be done in accordance with the Contract Documents before final payment will be released.

1.02 CLEANING

A. Clean the site in accordance with Section 5.02 of the General Conditions.

1.03 PROJECT RECORD DOCUMENTS

A. Provide one set of record documents in accordance with Section 7.11 of General Conditions.

B. Provide materials certifications as specified by the Engineer.

C. Submittal of the Record Documents shall be made with a transmittal letter containing:
   1. Date
   2. Project title and number
   3. Contractor’s name and address
   4. Title and number of each Record Document

1.04 GUARANTEES

A. Provide in accordance with Section 7.17 of the General Conditions.

B. Manufacturer's Guarantee:
   1. For each item of equipment, furnish the guarantee of the manufacturer.
   2. Guarantee that the equipment will perform its intended service and that any defective design or workmanship shall be corrected or replaced at no expense to the OWNER.
   3. The guarantee period of the manufacturer's guarantee shall be one year from the date of final payment of the project by the Owner, unless specified otherwise.

1.05 SUBSTANTIAL COMPLETION

A. Certification that the work is substantially complete shall be in accordance with Section 15.03 of the General Conditions.

1.06 FINAL INSPECTION AND PAYMENT

A. The final inspection, final application for payment and acceptance shall be in accordance with Section 15.05 through 15.06 of the General Conditions.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 02 20 00

ASSESSMENT

PART 1 GENERAL

1.01 STAKEOUT AND SURVEYING

A. Owners responsibility: Provide staking in accordance with Supplementary Conditions SC-4.05.A.

B. Contractors responsibility:
   1. Obtain field measurements, line and grade control, and facility locations based on guideline staking provided by the Owner.
   2. Preserve and protect all field staking provided by the Owner.
   3. Compensate the Owner for all costs of replacement of staking damaged by the Contractor.

1.02 SOIL BORINGS

A. Soil borings were conducted at the site and are shown on the Project Plans. Soil boring logs are included in Appendix A.

B. Accuracy of the logs is not guaranteed.

C. Boring logs indicate the conditions at the boring location only and do not necessarily reflect soil conditions elsewhere.

1.03 EXISTING UTILITIES

A. Existing utilities are shown on the Plans in their approximate location, based on the available data.

B. The Owner will not be responsible for omissions or variations from the locations shown.

C. Contact Miss Dig (1-800-482-7171) 72 hours prior to any excavation to locate existing buried utilities.

D. Preserve and protect existing utilities from damage. Repair all damage to existing utilities at no cost to the Owner. Work stoppages resulting from damaged utilities will not entitle the Contractor to additional payment.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 03 11 00

CONCRETE FORMING (ACI)

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:
Construction and removal of all cast-in-place concrete forms.

B. Related Sections:
1. Section 01 20 00 – PRICE AND PAYMENT PROCEDURE
2. Section 03 20 00 - CONCRETE REINFORCING
3. Section 03 15 00 - CONCRETE ACCESSORIES
4. Section 03 30 00 - CAST-IN-PLACE CONCRETE

1.02 QUALITY ASSURANCE

A. Codes and standards:
Perform all work in accordance with ACI 301 and ACI 347 of the American Concrete Institute (ACI) unless otherwise indicated on the Plans or in this Section.

B. Design:
The design, engineering and construction of formwork shall be the responsibility of the Contractor.

C. Notifications:
Notify the Engineer at least 24 hours in advance of placing concrete.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Formwork facing materials:
1. "As cast, smooth form finish" on all surfaces except footings as described in ACI 301-84, 10.2.2 Smooth Form Finish.
    a. Clean plywood, tempered concrete-form-grade hardboard, metal, plastic, paper, or other approved material.
    b. Supports capable of preventing excess deflection (See Table 4.3.1 for tolerances)
    c. Completely removable materials.
2. Obtain approval on quality of form face from Engineer prior to installing.
3. Clean, reasonably straight earth cuts, which meet the required tolerances, may be used to form footings with approval of the Engineer.

B. Form accessories:
1. Partially or fully embedded
    a. Commercially manufactured
2. Do not use non-fabricated wire.

C. Form ties:
1. Exposed concrete work:
    a. Single rod ties equipped with tightly fitted washers at the midpoint.
    b. Assembly should provide cone-shaped depressions at the form/concrete surface interface at least one inch diameter and 1 ½ inches deep to permit filling and patching.

2. Manufacturers:
   a. Dayton Sure-Grip
   b. Superior Concrete Accessories
   c. Williams Form Engineering Corporation
   d. or equal.

D. Form release agent:
1. Chemically neutral agent that will effectively prevent absorption of moisture and prevent bond with the concrete.
   a. "Magic Kote" 43000 by Symons; or approved equal.
2. Non-toxic release agent for forms used on the interior surfaces of storage tanks designed to hold potable water supplies.
   a. Amoco White Mineral Oil No. 31-USP, or equal.
3. Submit the name and sufficient documentation of the proposed form coating agent material to the Engineer for review.

PART 3 - EXECUTION

3.01 FORM CONSTRUCTION

A. General:
1. Provide all required materials in sufficient quantities so as not to delay the work.
2. Use forms rigid enough to maintain specified tolerances.
3. Design forms for the loads, lateral pressure, and allowable stresses outlined in ACI 347, Design of “Recommended Practice for Concrete Formwork” and in accordance with local building codes.

B. Formwork Facing
1. Arrange in an orderly and symmetrical manner
2. Keep the number of seams to a practical minimum

C. Form Ties
1. Construct to prevent appreciable spalling at the faces during removal of the end or end fasteners.
2. Terminate embedded ties at least twice the minimum dimension of the tie and never less than 3/4 inches from the formed face.
3. Exposed Concrete
   a. Do not leave any metal within 1-1/2 inches of the surface for concrete exposed to water, weather, freeze/thaw and similar exposures.
4. Provide positive pressure at all joints to preclude mortar/grout leakage.

D. Forms
1. Install forms sufficiently tight to prevent loss of mortar from the concrete.
2. Permanently exposed surfaces
   a. Provide 1" chamfer strips in the corners of forms.
   b. Interior corners on such surfaces and the edges of formed joints will not require beveling.
   c. Exposed surfaces include surfaces exposed to view or water.
3. Provide positive means of adjustment (wedge or jacks) of shores and struts.
   a. Take up all settlement during the concrete placing operation.
   b. Securely brace forms against lateral deflections.
   c. Camber the formwork to compensate for anticipated deflection.
4. Temporary openings
   a. Provide at the base of columns and wall forms for observation.

b. Where necessary to facilitate cleaning and observation.

5. Hold forms against the hardened concrete to maintain a true surface and to prevent offsets or loss of mortar at the construction joint.
6. Construct wood forms for wall openings to facilitate loosening and counteract swelling of the forms.
7. Adjust wedges if necessary to align forms.
8. Anchor formwork to prevent upward or lateral movement .
9. Runways
   a. Place directly on the formwork or structural member
   b. Do not rest on the reinforcing steel.
10. Form surfaces:
    a. Cover with an approved coating material in accordance with the manufacturer's recommendations.
    b. Do not allow coating to come in contact with reinforcing steel or hardened concrete.
11. Coordinate work with other trades.

E. Tolerances:
1. Construct formwork in conformance with the tolerance limits listed in Table 4.3.1 (ACI 301).

TABLE 4.3.1 - TOLERANCES FOR FORMED SURFACES

1. Variation from plumb:	
A. In the lines and surfaces of columns, piers, walls, and in arrises:	
In 10 ft of length	1/4 in.
Maximum for the entire length	1 in.
B. For exposed corner columns, control-joint grooves, and other conspicuous lines:	
In any 20 ft length	1/4 in.
Maximum for the entire length	½ in.
2. Variation from the level or from the grades specified in the contract documents:	
A. In slab soffits, ceilings, beam soffits and in arrises, measured before removal of supporting shores	
In any 10 ft of length	1/4 in.
In any bay or in any 20 ft length	3/8 in.
Maximum for the entire length	3/4 in.
B. In exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines:	
In any bay or in 20 ft length	1/4 in.
Maximum for the entire length	½ in.
3. Variation of the linear building lines from established position in plan and related position of columns, walls, and partitions:	
In any bay	½ in.
In any 20 ft of length	½ in.
Maximum for the entire length	1 in.
4. Variation in the sizes and location of sleeves,	

floor openings, and wall openings	+1/4 in.

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5. Variation in cross-sectional dimensions of columns and beams and in the thickness of slabs and walls:

Minus	1/4 in.
Plus	½ in.

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6. Footings*

A. Variations in dimensions in plan:	
Minus	½ in.
Plus	2 in.
B. Misplacement or eccentricity:	
2 percent of the footing width in the direction of misplacement but not more than	2 in.
C. Thickness:	
Decrease in specified thickness	5 percent
Increase in specified thickness	No limit

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7. Variation in steps:

A. In a flight of stairs:	
Rise	±1/8 in.
Tread	±1/4 in.
B. In consecutive steps:	
Rise	±1/16 in.
Tread	±1/8 in.

---

*Tolerances apply to concrete dimensions only, not to positioning of vertical reinforcing steel, dowels, or embedded items.

2. Maximum deflection of forms:
   a. 1/240 of span or 1/4 inch, whichever is less.
3. Establish and maintain control points and bench marks to check tolerances until final completion.

F. Inserts, embedded parts, and openings:
   1. Coordinate the location of inserts, embedded parts, openings, and recesses with the respective trades.
   2. Set and build into the work anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in-place concrete.
   3. Use setting drawings, diagrams, instructions and directions provided by suppliers of the items.

G. Field quality control:
   1. Clean and repair surfaces of forms to be re-used in the work.
   2. Do not use "patched" forms for exposed concrete surfaces.

3 Inform Engineer 24 hours to placing concrete to allow for formwork inspection.

3.02 REMOVAL OF FORMS AND SUPPORTS

A. Forms not supporting the weight of the concrete:
   1. Remove when the concrete has hardened sufficiently to prevent damage.

B. Forms and shoring used to support the weight of structural members:
   1. Do not remove until the concrete has reached 75 % of the design strength.
   2. See ACI 306 for cold weather applications.

C. If compression cylinder tests are not available, keep forms and supports in place for not less than the following periods of time:

	Where design live load is:	
Less than Greater than	dead load:	dead load:
Building walls		12-24 hr
Sides of beams and girders		12-24 hr
Floor slabs:		
Under 10 ft clear span between supports	4 days	3 days
10 to 20 ft clear span between supports	7 days	4 days
Over 20 ft clear span between supports	10 days	7 days

a. If high-early-strength concrete is used, or the ambient temperatures remain below 50°F, these periods may be modified at the discretion of the Engineer.

END OF SECTION

SECTION 03 15 00

CONCRETE ACCESSORIES (ACI)

PART 1 GENERAL

1.01 DESCRIPTION:

A. Section Includes:
Furnish and install all concrete accessories

B. Related Sections:
1. Section 01 20 00 – PRICE AND PAYMENT PROCEDURE
2. Section 01 33 00 – SUBMITTTAL PROCEDURES
3. Section 03 11 00 - CONCRETE FORMING (ACI)
4. Section 03 20 00 - CONCRETE REINFORCING (ACI)
5. Section 03 30 00 - CAST-IN-PLACE CONCRETE (ACI)

1.02 SUBMITTALS

A. Make submittals in accordance with Section 01 33 00

PART 2 PRODUCTS

2.01 MATERIALS:

A. Water stops:
1. Polyvinyl chloride waterstops
   a. 6 inches by 3/8 inches
   b. ribbed or serrated with center bulb (1.2 lbs/ft minimum)
2. Meet or exceed the physical property requirements set forth in the U.S. Corps of Engineers specification CRD-C572-74, or latest revision.
3. Greenstreak 705; Vinylex RB6-38; A. C. Horn Type 5; or equal.

B. Inserts for general trades:
1. Malleable iron, strength as required.
2. Include bolts, nuts, and washers.
3. Heckman Building Products, Hohmann & Barnard, Inc.; or equal.

C. Premolded expansion strips:
1. W.R. Meadows, Inc.; Celotex Corporation; or equal.
2. Asphalt impregnated fiberboard, ASTM D-1751.

D. Expansion joint filler:
1. Neoprene NN2 semi-rigid closed cell
2. Use bond breaker between joint filler and joint sealant.
3. Willaims Products Inc. Everlastic; or equal

E. Construction joint form for building floor slabs on grade:
1. Sixteen gauge, tongue and groove galvanized metal by Superior Concrete Accessories, Inc., Heckman Building Products Company; or equal.

F. Control joint form for building floor slabs on grade:
1. Twenty gauge galvanized steel.
2. Depth: 1/4 the slab thickness or more.

3. Heckman Building Products Company, Superior Concrete Accessories, Inc.; or equal.

G. Concrete stair nosings on cast-in place concrete stairs:
   1. Abrasive cast aluminum 4" wide, 6" shorter than tread
   2. Wooster type 101 with cast on anchors; or equal.

PART 3 EXECUTION

3.01 INSTALLATION

A. As indicated on the Drawings, specified in various other Sections, and as necessary for the proper and complete performance of this Work.

B. Waterstops:
   1. Install according to manufacturer’s recommendations.
   2. Perform all splices in length or at intersections by heat sealing in accordance with manufacturer’s recommendations.
   3. Hold in place with hog rings and wire tie as required.

C. Piping, mechanical and electrical equipment support:
   1. Inserts for hangers
      a. Supplied by the trade whose work is supported
   2. Location
      a. Given to the General Contractor by the various trades.
   3. Installation
      a. By the General Contractor.

END OF SECTION

SECTION 03 20 00 (ACI)

CONCRETE REINFORCING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
The furnishing and installation of all concrete reinforcement.

B. Related Sections:
1. Section 01 20 00 - PRICE AND PAYMENT PROCEDURE
2. Section 01 33 00 - SUBMITTAL PROCEDURES
3. Section 03 11 00 - CONCRETE FORMING
4. Section 03 15 00 - CONCRETE ACCESSORIES
5. Section 03 30 00 - CAST-IN-PLACE CONCRETE

1.02 SUBMITTALS

A. Make all submittals in accordance with Section 01 33 00 – SUBMITTAL PROCEDURES

B. Shop Drawings:
1. Submit Shop Drawings showing the number, size, length, mark, location, and bending diagrams for all reinforcement.
2. Prepare Shop Drawings in accordance with "Manual of Standard Practice for Detailing Reinforced Concrete Structures" of the ACI.

1.03 DELIVERY AND STORAGE

A. Reinforcement shall be stored above the surface of the ground on platforms, skids, or other supports and shall be protected from mechanical injury and surface deterioration caused by exposure to conditions producing rust.

PART 2 - PRODUCTS

2.01 MATERIALS

A. General:

1. All concrete reinforcement and accessories:
   a. New, free from paint, oil, and structural defects.
2. Reinforcement with rust and/or mill scale which meets the applicable ASTM standard is acceptable.

B. Reinforcing bars:
1. ASTM A 615, Grade 60

C. Welded wire fabric:
1. ASTM A 185 Fy = 65,000 PSI
2. Plain, cold drawn, electrically welded fabric

D. Accessories:
1. In conformance with CRSI "Manual of Standard Practice for Reinforced Concrete Construction".

2. Use plastic-tipped chairs and bolsters at exposed underside of concrete.

2.02 FABRICATION

A. General:
1. Fabricate reinforcement accurately to the dimensions indicated on the Drawings and the approved Shop Drawings, in accordance with the tolerance given in ACI 315.
2. Bend hooks in accordance with ACI 350.

PART 3 - EXECUTION

3.01 PLACING

A. Tolerances and clearance:
1. See CRSI "Placing Reinforcing Bars," latest edition.
2. Place bars to the following tolerances:

Clear Distance to Formed Surfaces:	±1/4 inch
Minimum Spacing Between Bars:	±1/4 inch
Top Bars in Slabs and Beams:	
Members 8 in. deep or less:	±1/4 inch
Members More than 8 in. but not over 2 feet deep:	±1/2 inch
Members More than 2 ft deep:	±1 inch
Crosswise of Members: spaced evenly within 2 inches	
Lengthwise of Members:	±2 inches

3. Move bars as necessary to avoid interference with other reinforcing steel or embedded items.
4. Minimum concrete protective covering for reinforcement shall be as follows, unless shown otherwise on the Drawings:
   a. Concrete deposited against the ground: 3 inches
   b. Slabs poured over a mud mat: 2 inches
   c. Top steel in floor slabs exposed to water or wastewater
      i. interior surface: 2 inches
      ii. exterior surface: 2 inches
   d. Formed surfaces exposed to weather or in contact with the ground:
      i. reinforcing bars #6 or larger: 2 inches
      ii. reinforcing bars less than #6: 1-1/2 inches
   e. Interior surfaces: 1-1/2 inches for beams, girders, and columns; 3/4 inches for slabs, wall and joists with #11 bars or smaller.

B. Installation:
1. Clean reinforcement of materials which adversely affect or reduce the bond. When reinforcement is placed in the work, reinforcement shall be free from dirt, loose rust or scale, mortar, paint, grease, oil, or other nonmetallic coatings that reduce bond. Epoxy coatings of reinforcing steel in accord with standards in this article shall be permitted. Reinforcement shall be free from all injurious defects such as cracks and laminations. Bonded rust, surface seams, surface irregularities, or mill scale will not be cause for rejection, provided minimum dimensions, cross-sectional area, and tensile properties of a hand wire brushed specimen meet the physical requirements for size and grade steel specified.
2. Support and fasten reinforcement to prevent displacement beyond the tolerances of paragraph 3.01A.
3. Supporting concrete blocks may be used on ground.
4. Use metal, plastic or other approved bar chairs and spaces over formwork.
5. Use plastic coated accessories within ½ inch of the formed concrete surface.

6. Over-lapped welded wire fabric:
   a. The overlap measured between the outermost cross wires of each sheet should be 2 inches or greater.
   b. Extend fabric across supporting beams and walls to within 4 inches of concrete edges.
   c. Adequately support the fabric during placing in accordance with paragraph 3.01.B.2 or by laying it on a layer of fresh concrete of the correct depth before placing the upper layer of the slab.
7. Offset vertical bars in columns at least one bar diameter at lapped splices.
8. Furnish template for all column dowels to insure proper placement.
9. Splices not shown in the Contract Documents must be approved by the Engineer.
10. Do not bend reinforcement embedded in hardened concrete.
11. Splice in conformance to "Reinforcing Bar Splices" latest edition by the Concrete Reinforcing Steel Institute and the "Building Code Requirements for Reinforced Concrete (ACI 350).
12. Circular ring tension steel laps: 40 bar diameters or greater
13. Place principal (moment-carrying) reinforcement in wall and slabs in the layer closest to the forms.
14. Place temperature steel at right angles to and in contact with the principal steel.

3.02 FIELD QUALITY CONTROL

A. Notify Engineer at least 24 hours prior to placement of concrete and when reinforcing is in place

END OF SECTION

SECTION 03 30 00

CAST-IN-PLACE CONCRETE (ACI)

PART 1 - GENERAL

1.01 DESCRIPTION

A. Section Includes:
Furnish, place and finish all cast-in-place concrete and accessories.

B. Related Sections:
1. Section 01 20 00 - PRICE AND PAYMENT PROCEDURE
2. Section 01 33 00 - SUBMITTAL PROCEDURES
3. Section 01 45 29 - TESTING AND LABORATORY SERVICES
4. Section 03 11 00 - CONCRETE FORMING (ACI)
5. Section 03 20 00 - CONCRETE REINFORCING (ACI)
6. Section 03 15 00 - CONCRETE ACCESSORIES (ACI)

1.02 QUALITY ASSURANCE

A. Codes and standards:
1. ACI 301 - "Specifications for Structural Concrete for Buildings"
2. ACI 350R - "Concrete Sanitary Engineering Structures"
3. ASTM C 94 - "Standard Specifications for Ready-Mixed Concrete".
4. ACI 318 - "Building Code Requirements for Reinforced Concrete”.

B. Tests:
1. Performed in accordance with Section 01410 - TESTING LABORATORY SERVICES and this Section.
2. Slump tests
   a. Per ASTM C 143 and C 172.
   b. Frequency:
      Once per truck
3. Compression cylinder tests
   a. Make and cure specimens per ASTM C 31
   b. Four specimens per test.
   c. Frequency: Once per day or every 50 yd^3 for each strength or type
4. Air-entraining test
   a. In accordance with ASTM C 231
   b. Frequency
      Each truckload.
5. Acceptance and evaluation
   a. Based on ACI 301 "Specifications for Structural Concrete for Buildings”.
   b. Hardened Concrete Testing
      I. May be required by Owner or Engineer
      ii. Per ASTM C 42 or ASTM C-31
      iii. In accordance with the ACI "Building Code for Reinforced Concrete" (ACI -318).

1.03 SUBMITTALS

A. General
Make submittals in accordance with Section 01300.

B. Mix designs:
1. ACI 211.1 - “Recommended Practice for Selecting Proportions for Normal and Heavyweight Concrete”
2. Furnish mix design(s) with test report(s) by an independent testing laboratory for each mix.
3. Furnish the following material content per cubic yard of each class of concrete furnished:
a. Dry weight of cement.
b. Saturated surface and dried weights of fine and course aggregates.
c. Quantities, type and name of admixtures.
d. Weight of water.
4. Provide product information on all components of mix design

C. Test reports:
1. Provide at 7 days and 28 days test reports in accordance with Section 01410.
2. Immediately notify the Engineer if any test specimen fails to meet the required specification tolerances.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Cement:
1. Portland cement
2. ASTM, C150
3. Type I

B. High early cement:
1. Portland cement
2. ASTM C150
3. Type III

C. Aggregates:
1. Fine and coarse aggregates
a. Conform to ASTM C 33.
2. Coarse aggregate
a. 1 inch maximum.
3. Limit coarse aggregate as follows:
a. Soft particles: 2.0%.
b. Chert as a soft impurity (defined in Table 3 of ASTM C 33): 1.0%;.
c. Total of soft particles and chert as a soft impurity: 2.0%;
d. Flat and elongated particles, long dimension more than five times short dimension: 15.0%.

D. Flyash: ASTM C 618

E. Water: Potable.

F. Admixtures:
1. Air entrainment: ASTM C260
2. Water reducing agents: ASTM C 494
3. Retarding agent at Contractor's option: ASTM C 494
4. Accelerating agent at Contractor's option: ASTM C 494
5. No admixture shall contain calcium chloride.

G. Membrane curing compounds:
1. Moisture retention properties: ASTM C 309.
2. Material compatible with application of other surface materials.

H. Base plate and equipment grout:
1. ASTM C 1107, “Specification for Packaged Dry, Hydraulic Cement Grout (Nonshrink)”.
2. CRD-C 621, “Corps of Engineers Specification for Nonshrink Grout.”

I. Epoxy bonding agent:
Concressive 1001-LPL, Adhesive Engineering Company; or equal.

J Skid resistant topping:
1. Furnish where called for on the plans
2. Install in accordance with manufacturer’s recommendation
3. Euclid Chemical Company, Cleveland, OH; Sonneborn Building Products, Minneapolis; or equal

2.02 CONCRETE MIX

A. Proportioning:
1. In accordance with ACI 211.1 - "Standard Practice for Selecting Proportions for Normal, Heavy Weight and Mass Concrete"
2. Selected and documented in accordance with ACI-318 - "Building Code Requirements for Reinforced Concrete"
3. Provide mix design, test records, calculations and other documentation to Engineer in accordance with Section 01300 - Submittals.

B. Specified compressive strength (f'c): 4000 psi.

C. Maximum water-cement ratio by weight:
1. 0.45 without superplasticizers
2. 0.40 with superplasticizers.
3. 0.39 structures in contact with wastewater

D. Cement factor
Based upon required strength with W/C ratio per ACI 211.1.

E. Air entrained concrete
1. Total air content:
a. 6% +- 1% for all concrete exposed to freezing and thawing, including all wastewater and potable water containment vessels.
b. 3% +- 1% for all other concrete.

F. Slump limits (Before Plasticizers)

		Max.	Min.
1.	Reinforced foundation walls and footings	3"	1"
2.	Unreinforced footings, caissons and substructure walls	3"	1"
3.	Reinforced slabs, beams and walls	4"	1"
		Max.	Min.
4.	Building columns	4"	1"
5.	Pavements	3"	1"
6.	Sidewalks, driveways and slabs on ground	4"	2"

2.03 PRODUCTION AND MIXING

A. Production:
   1. Ready mixed concrete
      Batched, mixed, and transported in accordance with ASTM C 94.
   2. Use only transit mixed concrete from NRMCA certified mixing plants or plant approved by the Engineer.
   3. Ready-mix delivery tickets:
      Furnish with each batch of concrete before unloading at the site with the following information:
      a. Name of ready-mix batch plant.
      b. Serial number of ticket.
      c. Date and truck number.
      d. Name of Contractor.
      e. Job name and location.
      f. Specific class or designation of concrete.
      g. Amount of concrete (cubic yards).
      h. Time loaded or of first mixing of cement and aggregates.
      I. Type, name and amount of admixture.
      j. Type, brand and amount of cement.
      k. Total water content by producer (or W/C ratio).
      l. Maximum size of aggregate.
      m. Weights of fine and coarse aggregates.

B. Mixing:
   1. Add water at the job site only if the total amount of water is equal to or less than that specified by the concrete mix design and slump remains within allowable limits.
   2. Mix 30 additional revolutions of the drum if water is added to mixed concrete at the job site.
   3. Completely discharge the concrete within 1-1/2 hours after introduction of mixing water to the cement or 1 hour after arriving at the site, whichever is sooner.
   4. If the ambient air temperature exceeds 85°F, the time may be reduced by the Engineer as required.
   5. Do not retemper concrete that has partially set.

C. Adjustments for weather conditions:
   1. Cold weather:

Minimum Ambient Air Temperature °F	Minimum Concrete Temperature °F
30 to 45	60
15 to 30	65
below 15	no concreting permitted

      Do not mix cement with water or aggregates above 100°F.
   2. Hot weather (ambient temperature 90°F. or above)
      a. Conform to "Recommended Practice for Hot Weather Concreting" ACI 305R.
      b. An approved set retarder will be permitted under hot weather conditions

PART 3 - EXECUTION

3.01 PLACING

A. Pre-placement inspection:
1. Inspect and complete:
a. Formwork installation
b. Reinforcing Steel
c. Embedded or cast-in items
2. Notify and cooperate with other Contractors and trades
3. Notify Engineer at least 24 hours in advance of pouring
4. Thoroughly wet wood forms immediately before placing concrete as required where form coating is not used.
5. Clean all mixing and transporting equipment
6. Remove all debris, water and ice before placing concrete.

B. Handling:
Prevent separation or loss of ingredients while transporting concrete.

C. Method and rate:
1. Place all concrete in accordance with:
a. ACI 304R - “Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete”
b. ACI 304.2R - “Placing Concrete by Pumping Method”
2. Place in a manner to avoid segregation.
3. Place concrete continuously until the panel or section is complete.
4. Do not deposit fresh concrete on hardened concrete, without a properly prepared cold joint.
5. Place horizontal layers with a maximum thickness of 18 inches.
6. Place concrete in columns, deep beams and walls with an elephant trunk or tremie to avoid segregation for vertical drops exceeding 3 feet.
7. Placing floors and slabs:
Place evenly over the entire area.
8. Protect new concrete from rain until it has hardened sufficiently to prevent damage.

D. Compaction:
1. Mechanically vibrate as concrete is places for a sufficient duration to accomplish thorough compaction and complete embedment of reinforcement and fixtures.
2. Do not vibrate long enough to cause segregation of mix.
3. Vibrators: Comply with ACI 309 - “Standard Practice for Consolidation of Concrete”
4. Do not use vibrators to transport concrete inside of forms.
5. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than the visible effectiveness of the machine.
6. Do not insert vibrators into lower layers of concrete that have begun to set.
7. Make at least two vibrators, all in good working condition, available for use during all pouring operations.
8. For large pours in excess of 50 cubic yards, three vibrators shall be available.

3.02 PROTECTION AND CURING

A. General:
1. Prevent the concrete surface temperature from falling below 50°F
2. Prevent loss of moisture from the surface:
a. Normal portland cement : 7 days.
b. High-early-strength portland cement: 3 days.

B. Curing:
   1. Treat all beams, columns, slabs and walls with a liquid membrane-forming curing compound as specified under Materials immediately after finishing or removing forms.
   2. Apply in strict compliance with manufacturer's instructions.
   3. Use alternate methods of curing such as ponding, continuous sprinkling, etc only with the prior approval of the Engineer.

C. Protection:
   1. Protect all freshly placed concrete from damage due to low temperatures when the mean daily temperature is below 40`F (4.5`C) in accordance with ACI 306R.

3.03 JOINTS AND EMBEDDED ITEMS

A. Construction joints:
   1. Joints not shown in the Contract Documents must be approved by the Engineer
   2. Continue all reinforcement across joints
   3. Provide longitudinal keys at least 1-1/2 inches deep:
      a. In all joints in walls
      b. Between walls and slabs or footings
   4. Before placing adjoining concrete:
      a. Thoroughly clean the joint surface
      b. Remove all laitance
   5. Roughen the concrete surface in an approved manner to obtain bond
   6. Refer to standard structural details for construction joint details.

B. Control joints:
   Construct control joints as outlined in Section 3.03A and as detailed on plans.

C. Expansion joints:
   1. Do not extend reinforcement or other embedded metal items bonded to the concrete (except dowels in floors, bonded on only one side of joints) continuously through any expansion joint.
   2. Premolded expansion joint filler
      a. Intersections of walls and slabs on grade unless otherwise shown
         I. "Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type)" (ASTM D 994)
      b. Slabs on grade where slab to slab is jointed.
         I. "Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)" (ASTM D 1751)

D. Waterstops:
   1. At joints as called for on the construction plans.
   2. See Section 03 15 00

E. Other embedded items:
   1. Placement of all embedded pipe, conduit and other fixtures is the responsibility of the Contractor.
   2. Conform to ACI 318.
   3. Place all sleeves, inserts, anchors, and embedded items required for adjoining work or for its support prior to concreting.
   4. Position and support expansion joint material, waterstops, and other embedded items against displacement.
   5. prevent the entry of concrete into sleeves, inserts, and anchor slots.

3.04 SURFACE TREATMENT

A. Patching:
1. Patch all poor joints, voids, honeycomb, defective areas and tie holes immediately after stripping forms.
2. Remove all laitance and foreign materials from areas to be patched by means of sandblasting.
3. Patch material
   A. Mortar with the same proportions as the concrete to be patched
   B. Omit coarse aggregate.
4. Bond patch material to concrete with a two-component liquid epoxy bonding agent in accordance with manufacturer's instructions and recommendations.
5. Use an epoxy adhesive for bonding plastic concrete to hardened concrete in conformance with "Standard Specification for Bonding Plastic Concrete to Hardened Concrete with a Multi-Component Epoxy Adhesive" - ACI 503.2, except as modified by the requirements of this project specification.

B. Wall finishes:
1. Remove all fins.
2. Repair all damaged areas, including those discolored, spalled, cracked or non-uniform in texture to the satisfaction of the Engineer.
3. Concrete surfaces exposed to view
   a. Finish exterior walls down to a point one foot below finished grade
   b. Finish interior surfaces of tanks to a point one foot below the water line
4. After repairing defects, apply an Engineer approved waterproof coating in accordance with manufacturer’s recommendations.

C. Troweling floors:
1. Trowel finish all floors.
2. After screeding and as soon as concrete has set sufficiently:
   a. Float surface
   b. Steel trowel surface
   c. Provide smooth, hard, dense finish free from trowel marks, blemishes, and irregularities.
3. Finish platforms, walks, drives, and steps to a broom surface.
4. Leave a 2 inch border around panels in sidewalks and platforms.
5. Power float slab areas which receive a topping or grout base and tile.

D. Membrane curing and sealer compounds:
1. Apply curing compounds immediately after stripping forms.
2. Apply compound per manufacturer’s recommendations and in accordance with ASTM C 309.

E. Skid resistant topping:
Apply in accordance with manufacturer's recommendations.

3.05 SPECIFIC ITEMS OF CONSTRUCTION

A. Liquid containing concrete tank and channel walls:
1. Install waterstops in all joints below maximum water level.
2. Immediately remove All seepage through cracks in walls by epoxy injection.

B. Expansion strips:
1. Where indicated on the Drawings
2. At intersections of building floor slabs and vertical surfaces
3. Around columns

C. Slab Toppings:
1. Toppings are required where indicated on the Drawings.
2. Immediately before pouring topping, wet down surface of rough slab.
3. Where topping is poured over precast-prestressed concrete members, set screeds to give indicated slab thickness at center of span.

E. Stairs and platforms:
Place abrasive nosings on all concrete stairs.

F. Base plate and equipment grouting:
1. Add only water and use mechanical mixer for minimum of three minutes.
2. Protect from freezing.
3. Cure in accordance with manufacturer's recommendation.

G. Miscellaneous items:
1. Perform all concrete work for mechanical and electrical trades including but not limited to vaults, valve and meter pits, light pole bases, and machine bases.
2. Accessories such as manhole rings, ladder rings, pulling eyes, anchor bolts, etc., may be furnished by other trade but installed by the Contractor.

H. Chamfer:
Chamfer all exposed concrete edges 1" x 1" unless otherwise indicated on the Drawings.

I. Grout:
"Grout" as called for on the Drawings and used as a topping slab or shaped fill for water flow shall be a 3000 psi or greater concrete mix. Sections requiring less than 2" thick shall have a maximum aggregate size of 3/8 inch.

3.06 HYDROSTATIC LEAK TESTS FOR CAST-IN-PLACE CONCRETE TANKS

A. General:
Cast-in-place concrete structures which are designed to normally be filled with liquid will be subjected to a hydrostatic leak test.

B. Test procedure:
1. Conduct the test before the tank is backfilled to allow visual observation of the floor slab - outer wall construction joint.
2. Fill each tank to its design liquid depth for a minimum period of 24 hours.
3. No visible leakage shall be allowed.
4. Any measurable loss of water over the 24 hour period shall be grounds for rejecting the test as unsatisfactory.
5. Empty, repair and retest the tank if the test fails.
6. All labor, equipment, and water required for testing each tank are the responsibility of the Contractor.

END OF SECTION

SECTION 04 22 00 - UNIT MASONRY

Standards: Comply with recommendations of Brick Institute of America (BIA), and National Concrete Masonry Assoc. (NCMA).

Submittals: Submit product data for masonry units, cementitious products for mortar and grout, coloring pigments, and masonry accessories. Submit samples of exposed masonry units and colored pigmented mortar.

Cavity Insulation: See Section 07 21 00.

Concrete Masonry Units (CMU): ASTM C 90, Grand N-I.

Provide “normal weight” units (min. 125 pcf) “single core’s” except where “lightweight” units (max. 105 pcf) are indicated, in general:

Interior and Exterior Walls Below Grade:

Stand CMU - normal weight.

Interior Walls Above Grade:

Standard CMU - lightweight, earth blend or approved equal.

Provide “bullnose” CMU at all exterior corners of interior walls.

Exterior Walls Above Grade:

Grade to 7’-4” A.F.F. (11 courses) single scored, earth blend, normal weight.

7’-4” to 8’-8” A.F.F. (2 courses) triple scored, earth blend split face, normal weight.

Above 8’-8” (5 courses, single scored), earth blend, normal weight.

All exterior concrete block, both decorative and regular including precast lintels and/or sills, shall contain the recommended amount of integral water-repellent known as the “DRY BLOCK SYSTEM. Block Admix” as manufactured by Forrer Chemical Company, Milwaukee, Wisconsin

Mortar Materials and Mixes: Provide mortar complying with ASTM C 270, Proportion Specification, for materials and mortar typed of composition indicated below:

Cementitious Material: Portland cement, Type 1, no air entertainment, white or natural color as required to produce mortar color indicated, combined with hydrated lime, Type S, ASTM C 207.

Aggregate: Natural or manufactured sand, ASTM C144.

Colored Mortar Pigments: Natural and synthetic iron oxides and chromium oxides compounded for mortar. Color to be selected by Architect.

Additive: All exterior block walls shall be laid with mortar containing the DRY BLOCK SYSTEM integral mortar admix as per label instructions, including attention NCMA TEK 53 for joint and crack control and NCMA TEL 13 TEK 126 for proper flashing.

Masonry Mortar Exterior and Bearing Walls: ASTM C 270, Type S; approximately 3 : 1 : 11 portland cement, lime, sand. Mortar to be colored.

Masonry Grout, Reinforced CMU: ASTM C476, use type PL mortar proportioned by volume; one part portland cement, 2-1/4 to 3 parts sand.

Masonry Mortar, Interior: ASTM C 270, Type N; approximately 3 : 2 : 14 portland cement, lime, sand.

Setting Bed Mortar: ASTM C 270, Type M; approximately 6 : 1 : 18 portland cement, lime sand.

Do not add admixtures unless otherwise indicated.

Select and proportion pigments with other ingredient to produce mortar color indicated; do not exceed pigment-to-cement ratio of 1- to 10, by weight.

Machine mix to match color selected by Architect.

Joint Reinforcement, Ties and Anchoring Devices: Comply with requirements indicated below for basic materials and with those indicated under each item.

Zinc-Coated Wire: ASTM A 82 for uncoated wire, ASTM A 641, Class 3 for zinc coating.

Joint Reinforcement: Welded-wire units prefabricated with deformed continuous side rods and plain cross rods into straight lengths of not less than 10' and of widths to fit wall thicknesses indicated, with prefabricated corner and tee units, and as follows:

Continuous Masonry Wire Reinforcing: Truss or ladder design, minimum 9 gauge welded steel wire, 0.8oz. hot-dip coating (after fabrication) for exterior walls, mill-galvanized wire for interior walls, width 1-1/2 to 2" less than wall thickness.

Miscellaneous Masonry Anchors: Fabricated fro 16 gage steel sheet or 3/8" steel rod, 1.5 oz. hot-dip zinc coating after fabrication.

Concealed Flashing Materials: Provide materials as follows:

Vinyl Masonry Flashing: PVC with plasticizers and modifiers, formed into a 20-mil flexible sheet.

Weepholes: Polyethylene plastic tubing, 1/4" x 4".

Insulation:

Loose Granular Perlite Insulation: See Section 07 21 00 - Thermal Insulation.

Install masonry units in running bond. Scored lines to match up. Horizontal joint between single and triple scored units to be raked joint, all others tooled.

Copper Asphalt Masonry Flashing: 3-oz. copper sheet with flexible fibrated asphalt coating on both faces.

Cut exposed masonry units, where necessary, with a power saw.

Avoid the use (by proper layout) of less-than-half-size units.

Bond intersecting walls with masonry units or provide anchors spaced 2"-0".

Hold uniform joint sizes as indicated, or if not indicated, hold joint sizes to suit modular size of masonry

units.

Cut joints flush and tool slightly concave, unless otherwise indicated.

Reinforce horizontal joints with continuous masonry joint reinforcement, spaced 24" vertically; and except spaced 8" in parapet walls, and immediately above and below openings, for a distance of 2' beyond jambs of opening. Do not bridge control and expansion joints in the wall system.

Anchor ends of walls to structure with anchors spaced 2'-0", except as otherwise shown.

Provide control and expansion joints at locations shown, and keep clean of mortar droppings.

Provide concealed flashing in exterior masonry work as indicated.

Except as otherwise shown, provide flashing under copings and sills, through wall at counterflashing locations, and above elements of structural support for masonry.

Build other work into the masonry work as shown, fitting masonry units around other work, and grouting for secure anchorage.

Protect newly laid masonry from exposure to precipitation, excessive drying, freezing, soiling, backfill and other harmful elements.

Dry-brush masonry work at end of each day's work.

Final Cleaning: After mortar is thoroughly set and cured, clean masonry as follows:

Remove large mortar particles by hand with wooden paddles and non-metallic scrape hoes or chisels.

Test cleaning methods on sample panels before proceeding with cleaning of entire masonry work.

Clean concrete unit masonry to comply with masonry manufacturer's directions and applicable NCMA "Tek" bulletins.

END OF SECTION

SECTION 05 99 00

MISCELLANEOUS METALS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Provide and install all miscellaneous metal items indicated on the Drawings and specified herein, and as necessary for the proper and complete performance of this work.

B. The following items are specified in detail within this Section:
1. Structural Steel
2. Anchors
3. Aluminum Access Hatch
4. Aluminum Bar Screen

C. The following items are also part of this Section and must meet general specification parameters: miscellaneous plates, inserts, structurals, fasteners, and all other fabricated metal items necessary for a complete and operable installation.

D. Related Section: 03 20 00 - CONCRETE REINFORCEMENT

1.02 REFERENCE STANDARDS

A. Applicable standards for material and construction shall be current editions of the following:
1. American Society for Testing Materials.
2. Manual of Steel Construction of the American Institute of Steel Construction.
3. Steel Joist Institute.
4. American Iron and Steel Institute's "Specification for the Design of Light Gauge Cold Formed Steel Structural Members".
5. Standard Specifications of the Steel Deck Institute.

B. Stair, ladder, railing, and walking surfaces:
1. Michigan Occupational Safety and Health Act Standards
2. Federal and local safety standards as they apply for floor and wall openings and general hazards regarding falling.

C. Welding:
1. Use certified welders.
2. American Welding Society "Structural Welding Code" and "Standard Code for Welding in Building Construction" (the term "Building Commissioner" when cited in the codes shall be interpreted to mean "ENGINEER").

D. Bolted connections:
1. "Specification for Structural Joints Using ASTM A-325 or A-490 Bolts" approved by the Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation including commentary by the AISC.

E. In the event of conflict between pertinent codes and regulations and the requirements of the referenced standards or these Specifications, the provisions of the more stringent shall govern.

1.03 SUBMITTALS

A. General:

Make all submittals in accordance with Section 01300 - SUBMITTALS

B. Shop drawings and/or manufacturer's literature:
Submit shop drawings for all custom work specified in this Section. Where standard products are specified and no modification will be required, submit manufacturer's literature.

1.04 PRODUCT HANDLING AND DELIVERY

A. Prefabricated items
1. Ship to prevent damage prior to installation.
2. Store to prevent weather damage prior to installation.

B. Steel
1. Store free from contact with the ground and to minimize water holding pockets, soiling, contamination and deterioration of the paint film.

C. Anchor bolts and other anchorage devices cast into concrete and masonry
1. Deliver to be installed before the start of concrete or masonry operations.

PART 2 - PRODUCTS

2.01 GENERAL PROVISIONS

A. Unless otherwise noted on the Drawings or in these Specifications, use steel for miscellaneous metal items.

B. Structural steel shapes, plates and bars: ASTM A36 "Specification for Structural Steel".

C. Hot galvanized coatings:
1. ASTM A123 "Specification for Zinc (Hot-Galvanized) Coating on Structural Steel Shapes, Plates, and Bars and/Their Products"
2. ASTM A446 "Specification for the Physical quality of Zinc-Coated (Galvanized) Steel Sheet by the Hot-Dip Process".

D. Use prime paints and finish paints that comply with Section 09 90 00.

E. Aluminum:
1. ASTM B209 (6061-T6) for plates,
2. ASTM B221 (6061-T6) for extrusions, and
3. ASTM B429 (6061-T6) for pipe, unless noted otherwise.

F. Stainless steel:
1. ASTM A312 for pipes and
2. ASTM A412 for plate, sheet, and strip, unless noted otherwise.

G. Bolt or weld all shop-fabricated metal assemblies:
1. Framing bolts: ASTM A307 (where normal strength bolts can be used), or
2. ASTM A325M (where high-strength bolts are required.)
3. Welds: AWS A5.1, E70XX welding electrodes.

2.02 ANCHORS

A. Manufacturers:
1. Wej-It Corp.,
2. Red Head Flush,

3. Phillips Drill Co.,
4. Hilti,
5. or approved equal.

B. To concrete and solid masonry materials
1. Mild steel wedge anchors with nuts and bolts suited to the item requiring attachment.
2. Heavy head hex nuts and washers for structural anchoring, unless indicated otherwise.
3. Specific applications of anchoring to solid masonry:
a. Log shield and/or lead caulking anchors may be substituted for wedge anchors with written approval of Engineer.
4. Anchoring to drywall, plaster, paneling, hollow masonry and similar surfaces
a. Toggle bolt or expanding hollow wall anchors.

C. Install all anchors in strict accordance with manufacturer's recommendations.

2.03 ALUMINUM FLOOR HATCHES AND FRAMES

A. Design standards:
1. Live load: 150 lbs psf
2. Maximum deflection: 1/100th of span.
3. Frames:
a. Minimum 1/4 inch thick aluminum frames with neoprene cushion and strap anchors bolted to exterior.
b. Apply bituminous coating to surfaces that will be in contact with concrete.
4. Hatches:
a. Minimum 1/4 inch thick aluminum door leaf(s) reinforced with aluminum stiffeners as required.
b. Open at stiffeners as required.
c. Open at least 90 degrees and that lock in the open position.

B. Manufacturers
a. Type "K" or "KD" hatches by Bilco. Co.,
b. Type "FB" hatches by Babcock-David Hatchway, Inc.,
c. or equal or as noted on plans.

PART 3 - EXECUTION

3.01 WORKMANSHIP

A. As far as practical, shop assemble all miscellaneous metal items. Make field measurements prior to shop assembly to ensure proper fit of shop fabricated items.

B. Install all items in accordance with manufacturer's instructions.

C. Install miscellaneous metal work so that corners are square, vertical lines are plumb, and horizontal lines level.

D. Properly anchor all miscellaneous metalwork. Coordinate with the work of other Sections where inserts and/or anchors must be embedded in concrete.

E. Torch cutting of galvanized steel shall not be permitted. Minor saw cutting of galvanized steel may be performed by the expressed approval of the Engineer.

3.03 PAINTING

A. Paint steel items in accordance with the requirements of Section 09 90 00 except for areas to be embedded in concrete, surfaces to be welded, and contact surfaces to be high-strength bolted.

B. For shop-fabricated items, as soon as practicable after fabrication, shop prime all miscellaneous metalwork that is to receive paint. Promptly touch up broken, abraded, or scratched surfaces that result from damage during delivery, handling, and/or erection. Promptly apply prime paint to bare metal that is exposed during filed joining of materials and miscellaneous metal items that have not been previously prime painted.

END OF SECTION

SECTION 06 11 00 - CARPENTRY

General Carpentry Materials:
Lumber Standard: Am. Softwood Lumber Std. PS 20 (U.S. Dep. Comm.), S4S, 19% moisture at time of dressing, except as otherwise indicated.

Light Framing (4 x 4 Max.): "Standard" grade any species.

Structural Framing 2 x 6 to 4 x 14): "No. 2" grade, Fir or Hem-Fir.

Stress Grade: 1200 psi minimum, factor marked.

Exposed board Lumber: Select clear redwood of sizes noted on Drawings.

Concealed Board Lumber: Southern Pine "No. 3" (SPIB), any species "No. 4" (WCLIB) or any species "Standard" (WWPA).

Plywood Standard: Softwood plywood - Construction and Industrial PS 1 (U.S. Dep. Comm.), type and grade as indicated.

Provide plywood bearing DFPA grade - trade marks.

Plywood Sheathing: C/D,INT-APA, exterior glue or OSB (Oriented Slant Board).

Preservative pressure treated lumber and plywood with water-borne preservatives to comply with AWPA C2 and C9, respectively, and with requirements indicated below:

Kiln-dry to 15% moisture content after treatment, except for wood in contact with ground.

Wood for Above-Ground Use: AWPB LP-2.

Treat cants, nailers, blocking, furring, stripping and similar items in conjunction with roofing, flashing, vapor barriers, and waterproofing.

Treat sills, sleepers, blocking, furring, stripping and similar items in direct contact with masonry or concrete.

Treat ground-contact and water-immersed wood items in accordance with standard for ground contact.

Fire-Retardant Treated Wood: Where wood is indicted for fire-retardant treatment comply with AWPA C20 (lumber) and AWPA C27 (plywood). Provide UL label in each piece treated. Re-dry treated lumber.

Installation:

Install rough carpentry work to comply with "Manual of House Framing" by National Forest Products Assoc. (N.F.P.A.) and with recommendations of American Plywood Association (APA), unless otherwise indicated. For Sheathing, underlayment and other products not covered in above standards, comply with recommendations of manufacturer of product involved for use intended. Set carpentry work to required levels and lines, with members plumb and true and cut to fit.

Install finish carpentry work plumb, level, true and straight with no distortions. Shim as required using concealed shims. Scribe and cut finish carpentry items to fit adjoining work. Anchor finish carpentry work securely to supports and substrates, using concealed fasteners and blind

nailing except as indicated, countersunk and filled flush with finished surface.

Trussed Rafters: Comply with “Light Metal Connected Wood Trusses” by Truss Plate Institute., and with “Nat. Design Specs. for Stress Graded Lumber and Its Fasteners” by NDMA.

Submit manufacturer’s Shop Drawings for approval with an engineers seal.

Glued Laminated Structural Units Standard: Comply with PS 56 “Structural Glued Laminated Timber” kk min. bending stress (FC) = 2400 psi; grade industrial.

Nail plywood or oriented strand board sheathing 6” o.c. at edges of panels, and 12” o.c. at intermediate supports. Leave space between panels as recommended by APA.

Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces from maximum length of lumber available. Cope at returns, miter at corners to produce tight fitting joints. Use scarf joints for end-to-end joints.

Securely attach carpentry work to substrates and supporting members using fastener of size that will not penetrate members where opposite side will be exposed to view or receive finish materials. Install fasteners without splitting wood; fasten panel products to allow for expansion at joints unless otherwise indicated.

END OF SECTION 06 11 00

SECTION 06 17 00 - PREFABRICATED WOOD TRUSSES

General:

Standards: Comply with N.F.P.A. National Design Specification and with TPI standards including “Quality Standard for Metal Plate Connected Wood Trusses”, “Commentary and Recommendations for Handling and Erecting Wood Trusses”, Commentary and Recommendations for bracing Wood Trusses” and the following:

“Design Specification for Metal Plate Connected Wood Trusses”.

Submittals: In addition to product data for truss components submit the following:

Shop drawings showing sizes, design values, materials, and dimensional relationships of components as well as bearing and anchorage details.

To extent engineering design considerations are fabricator’s responsibility, submit design analysis and test reports indicating truss performance characteristics and compliance with requirements.

Provide shop drawings which have been signed and stamped be a structural engineer licensed to practice in jurisdiction where trusses will be installed.

Certification, signed by officer of fabricating firm, indicating trusses comply with project requirements.

Handle and store trusses with care and to comply with TPI recommendations to avoid damage form bending, overturning or other cause.

Products:

Lumber: Provide lumber S4S, S-Dry unless otherwise indicated grade marked, complying with PS 20 and requirements indicated.

Lumber Species: Any softwood, at Contractor’s option, graded under WWPA, WCLB, SPIB or NLGA rules, which complies with other requirements.

Lumber Grade: Any grade fulfilling requirements indicated.

Stress Rating: Provide lumber which has been graded or tested and certified to comply with stress ratings indicated.

Metal Connector Plates: Metals and thickness as indicated, but not less than thickness indicated below:

Hot-Dip Galvanized Sheet Steel: ASTM A 446, Grade A, G60, 0.036” thick.

Fasteners and Anchorages: Of size, type, material and finish suited to application shown.

Fabrication: Fabricate and assemble trusses to provide units of configuration indicated, with closely fitted joints and connector plates securely fastened to wood members.

Installation:

Install trusses to comply with TPI referenced standards and other indicated requirements.

END OF SECTION 06 17 00

SECTION 06 74 00

COMPOSITE GRATINGS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work included:
   1. Fiberglass grating

1.02 RELATED SECTIONS

1. Section 01 20 00 - PRICE AND PAYMENT PROCEDURE
2. Section 01 33 00 - SUBMITTAL PROCEDURES

1.03 UNIT PRICES

A. Refer to Section 01 20 00 - PRICE AND PAYMENT PROCEDURE

1.04 SUBMITTALS

A. General:
Make all submittals in accordance with Section 01 33 00 - SUBMITTAL PROCEDURES.

B. Shop drawings:
Submit shop drawings showing dimensions and details of construction and installation. Catalog literature will be sufficient for stock items.

C. Installation instructions:
Submit complete installation instructions.

PART 2 PRODUCTS

2.01 FIBERGLASS GRATING

A. Design standards:
   1. BOCA Code required superimposed uniform, and concentrated live loads for the area in which the grating is located.
   2. Maximum deflection: 1/4 inch.
   3. Minimum uniform live load: 100 psf.

B. Grating shall be pultruded fiberglass grating as manufactured by IKG Borden Fiberglass, or equal.

C. Model:
   1. 5' span or greater: Corgrate WT, 2"WT50PF.
   2. Spans less than 5': Corgrate WI, 1-1/2" WI60PF.

D. Provide grating with gritted surface for skid resistance.

E. Grating shall be formulated with premium grade isophthalic polyester resin meeting ASTM E 84 Class I flame spread rating.

F. Grating shall be manufactured with a resin system providing protection against ultraviolet degradation.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install all equipment in compliance with printed instructions as furnished by the manufacturer.
B. Install join in gratin to allow for access to slide plates and stop logs.

END OF SECTION

SECTION 06 80 00

COMPOSITE FABRICATIONS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Furnishing and installation of fiberglass ladders, handrail systems, and stairs.

1.02 DESIGN REQUIREMENTS

A. Suitable for constant exposure to corrosive environments.

B. Ladder, safety cages, handrail systems, and stairs designed to meet all applicable safety requirements, including applicable OSHA and BOCA standards.

C. Handrail system:
1. Square tube design
2. Internal fittings for all connections.
3. OSHA pp. 1910.23 entitled, "Guarding Floor & Wall Openings"
4. Concentrated Load (vertical and horizontal) at any point on top rail: 1000 lbs
5. Maximum deflection under 200 lb concentrated vertical load: 3/16"
6. Joints: bonded and mechanically fastened using non-metallic hardware
7. Toe plates: run true with the guardrail

D. Ladders and cages:
1. OSHA pp. 1910.27 entitled "Fixed Ladders"
2. Vertical concentrated load at midspan: 1200 lbs
3. Ladders:
   a. Channel side rails
   b. Entirely non-metallic with exception of stainless steel spliced and mounting systems.
4. Rungs:
   a. Keyed and bonded to side rails
   b. Factory applied grit non-skid surface

E. Stairs:
1. Pultruded structural fiberglass shapes.
2. Minimum design live load: 100 psf
3. Stair tread concentrated center load: 300 lbs
4. Land concentrated load at any location: 1000 lbs
5. Open type with channel stringers.
6. Joints: bonded and mechanically fastened using non-metallic hardware.
7. Dimensions as indicated on the plans.

1.03 SUBMITTALS

A. General:
Make submittals in accordance with Section 01 33 00 - SUBMITTAL PROCEDURES.

B. Show drawings:
Submit shop drawings showing dimensions and details of construction and installation. Catalog
literature will be sufficient for stock items.

C. Installation instruction :
Submit complete installation instructions.

PART 2 - MATERIALS

2.01 MATERIALS

A. Pultruded structural fiberglass shapes, utilizing a synthetic surfacing veil for maximum chemical
and ultraviolet resistance.

B. The resin, reinforcement, pigmentation, fillers and other materials when combined as a composite structure shall produce a structure capable of meeting the Design Requirements outline in paragraph 1.02 above.

C. All FRP shapes shall possess Class I fire retardance, with an ASTM E-84 flame spread rating of
25 maximum.

D. Standoff clips on ladders shall be on maximum 6 foot vertical centers.

E. Handrails
1. Mount to concrete floor according to manufacturer's recommendations.
2. Pedestal mounts, vertical face bolting, or grout embedment are acceptable.
3. Dimensions as shown on the plans.
4. Maximum vertical post spacing: 6" on center.

F. Color: Safety yellow

G. Seal all cut edges and holes with a compatible resin system.

H. Manufacturer:
1. IMCO Reinforced Plastics
2. Fowler Fiberglass Grating
3. IKG Borden
4. or Equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Comply with printed instructions as furnished by the manufacturer.

B. Handrail system: supplied as standards components or shop fabricated.

END OF SECTION

SECTION 07 11 00 – DAMP PROOFING

GENERAL

Description of Work

Extent of each type of fluid applied waterproofing work is shown on drawings. Fluid applied waterproofing is hereby defined to exclude similar membranes used as exposed finish for roofing, flooring, or special coatings.

Types of fluid applied waterproofing required for project include the following:

Single-component, bitumen-modified, moisture curing polyurethane.

QUALITY ASSURANCE

Manufacturer: Obtain primary waterproofing materials of each type required from single manufacturer with not less than three years of successful experience in supplying principal materials for FA-WP work. Provide secondary materials only as recommended by manufacturer of primary materials.

Installer: A firm which has specialized in installation of types of waterproofing required for project for not less than three years and which is not unacceptable to manufacturer(s) of primary materials.

As applicable, assign work closely associated with waterproofing, including (but not limited to) waterproofing accessories, flashings in connection with waterproofing expansion joints in membrane, and protection course on membrane, to installer of waterproofing, for undivided responsibility.

SUBMITTALS:

Product Data: Submit manufacturer's specifications, installation instructions, and general recommendations for each waterproofing material required. Include data substantiating that materials comply with requirements.

JOB CONDITIONS:

Substrate: Proceed with work of this section only after substrate construction and penetrating work have been completed.

Weather: Proceed with work of this section only when existing and forecasted weather conditions will permit work to be performed in accordance with manufacturer's recommendations.

Ventilation: Provide adequate ventilation to prevent accumulation of hazardous fumes during application of solvent- based components in enclosed spaces, and maintain ventilation until coatings have thoroughly cured.

PRODUCTS

MATERIALS:

General Compatibility: Provide products which are recommended by manufacturer to be fully compatible with indicated substrates, including modification by bituminous additives

(Asphalt or coal tar as needed) and similar proven compounding provisions.

Single-Component, Bitumen-Modified, Polyurethane: Polyurethane rubber based liquid membrane material, self- bonding to normal substrates, compounded specifically for application method to be used and for slope of substrate, not less than 97% solids and 6-month shelf life in uncured state.

Products/Manufacturers: Provide one of the following:

Mameco 101

Sonoborn HLM

Tremco 60

Miscellaneous Materials:

Primer/Filler/Sealer: As recommended by manufacturer of FA-WP liquid compound and as indicated.

Flashing, Cant Strips, and Accessories: As recommended by manufacturer of FA-WP liquid compound and as indicated.

Protection Course (PRT CRS): Rigid asphalt/asbestos composition board, 1/8" thick, formed under heat and pressure, standard sizes.

EXECUTION

INSPECTION

Installer must examine substrate and conditions under which waterproofing work is to be performed and must notify Contractor in writing of unsatisfactory conditions, do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

PREPARATION OF SUBSTRATE:

Clean substrate of projections and substances detrimental to work; comply with instructions of prime materials manufacturer.

Install cant strips and similar accessories as shown and as recommended by prime materials manufacturer even though not shown, which particular attention at construction joints. Fill voids, seal joints, and apply bond breakers as recommended by prime materials manufacturer.

Prime substrate as recommended (and Only if recommended) by prime materials manufacturer.

Mask off adjoining surfaces not to receive FA-WP, to effectively prevent spillage or over-spray of liquid materials outside membrane area.

INSTALLATION:

General: comply with manufacturer's instructions, except where more stringent requirements are shown or specified, and except where project conditions require extra precautions or provisions to endure satisfactory performance of work.

Apply uniform coating of FA-WP to substrate and adjoining surfaces indicated to receive membrane. Apply coating complying with manufacturer's recommendations regarding horizontal and vertical surfaces.

Provide 60-mil (average) coating, with no variations below 50-mil thickness.

Install sheet-type flashings and joint covers as recommended by prime materials manufacturer. Except as otherwise shown, extended flashings to not less than 4" beyond finished surface to be applied over waterproofing.

Permit membrane to cure under conditions which will not contaminate or deteriorate FA-WP material. Block off traffic and protect membrane from physical damage.

Protection Course:

Install protection course (PRT CRS) on cured membrane (after testing, if required) without delay, so that period of exposure will be minimized.

On vertical surfaces comply with FA-WP manufacturer's recommendations for adhesion of protection course to membrane.

END OF SECTION 07 11 00

SECTION 07 21 00 - THERMAL INSULATION

General:

Provide insulation thickness indicated, or provide combination of thickness and K-value required to yield the “R” value indicated.

Perimeter and Under Slab Insulation:

Extruded Polystyrene Insulation Board: FS HH-I-524C, Type IV, Class B, self-skinned, K-value of 0.20.

Provide:

“Dow Styrofoam” by
Dow Chemical U.S.A.

“Formula R 250” by
UC Industries

Vertical Application: Set in mastic adhesive as recommended by manufacturer.

Ceiling Insulation:

Faced Mineral Fiber Blanket/Batt Insulations: ASTM C 665 for Type III, Class A (blankets with reflective vapor- retarder membrane facing with flame spread of 25 or less; foil-scrim-kraft vapor-retarder membrane on one face, respectively; and as follows;

Mineral Fiber Type: Fibers manufactured from glass or slag.

Loose Organic Fiber Insulation: Cellulosic fibers (reprocessed newsprint or other) process with fire-retardant, vermin-resistant and neutralizing chemicals for blowing or pouring in place, complying with FS HH-I-515, Class 25, 2 lb. minimum in-place density, k-valve of 0.28; tested and labeled by UL for critical radiant flux of 12 W per q cm (CPSC 16CF-1209), 15% smoldering combustion, “Acceptable” for corrosiveness, moisture absorption, odor emission, fungal growth and permanence of flame-resistance, and “Negative” on starch content.

Loose Granular Masonry Cavity Insulation:

Granular Perlite Insulation: FS HH-I-574 or ASTM C 549, k-value of 0.33, silicone treated where used in exterior walls.

The insulation shall be installed in the cores of all exterior hollow masonry unit walls.

The insulation shall be poured directly into the wall at any convenient interval. Wall sections under doors and windows shall be filled before sills are placed.

All holes and openings in the wall through which insulation can escape shall be permanently sealed or caulked prior to installation of the insulation. Cooper, galvanized steel, or fiberglass screening shall be used in all weep holes.

Stud Partitions Interior and Exterior Walls:

Glass Fiber Blanket/Batt Insulation: Inorganic nonasbestos fibers formed with binders into

resilient blankets or batts complying with HH-I-521, semi-rigid type where required for self support. (3-1/2 / 5-1/2 as indicated).

Installation, General:

Comply with insulation manufacturer's printed instructions and recommendations for the installation for each type of thermal insulation. Provide adequate anchorage or support for each unit. Insulate at all wood-on block plates, all possible openings in walls and ceilings (i.e., window and door frames, headers), around all inside plumbing lines and between plumbing lines and outside walls.

END OF SECTION 07 21 00

SECTION 07 25 00 - VAPOR BARRIERS

General:

For use below all slabs and gypsum ceilings.

Elastic Sheet Vapor Barriers VB:

Polyethylene Vapor Barrier VB: 6-mil carbonated polyethylene film, rated 0.1 perms for less.

Installation:

Seal VB at seams, perimeter, obstruction and penetrations, with adhesive, sealant or tape recommended by manufacturer.

Anchorage: Install vapor barriers with adhesive or fasteners as appropriate for supporting substrate, and of type recommended by vapor barrier manufacturer.

Provide lapped seams and lap vapor barriers onto other work at edges of coverages and at penetrations of barriers by other work.

Seal lapped seams and laps onto other work with adhesive or self-adhesive tape of type recommended by vapor barrier manufacturer. Before covering over vapor barriers with other (concealing) work, patch punctures and tears with adhesively applied barrier material or tape with perm rating equal to barrier rating.

END OF SECTION 07 25 00

SECTION 07 31 13 - ASPHALT SHINGLES

Delivery, Storage, and Handling: Deliver materials in manufacturer's unopened, labeled bundles, rolls or containers. Store materials to avoid water damage, and store rolled goods on end. Comply with manufacturers recommendations for job-site storage and protection.

Job Conditions: Proceed with shingle installation only when all penetrating work has been completed and when substrate is dry and weather conditions are favorable.

Asphalt Shingle Roofing:

Square Tab Strip Shingles, UL Class "A", Standard Weight": Mineral-surfaced, self-sealing, 3-tab fiberglass based asphalt strip shingles complying with ASTM D 3018, bearing UL Class "A" external fire exposure label and UL "Wind Resistant" label, weighing not less than 215 lbs. per square. Color to be "Weathered Wood." Shingle to have 40 year guarantee.

Firescreen; Bird & Son/Genstar Building Materials Co. Fiberglass Asphalt/20; The Celotex Corp.
Glassguard; Certainteed Corp.
Brigade: Flintkote/Genstar Building Materials Co.
Sentinal; GAF Corporation.
Toughglass; Georgia-Pacific.
Fireglass III, Manville Building Materials Corp.
Classic Plus; Owens-Corning Fiberglas Corp.

Roofing Felt: No. 15, asphalt-saturated unperforated organic roofing felt, complying with ASTM D 226, Type 1, 36" wide, approximate weight 18 lbs/square.

Asphalt Plastic Cement: Fibrated asphalt cement complying with ASTM D 2822, designed fro trowel application.

Nails: Aluminum or hot-dip galvanized 11 or 12-gage sharp pointed conventional roofing nails with barbed shanks, minimum 3/8" diameter head, and of sufficient length to penetrate minimum 3/4" into solid decking or to penetrate through plywood sheathing.

Staples: Minimum 16-gage zinc-coated steel roofing staples with minimum crown width of 15/16" and of sufficient length to penetrate 3/4" into deck lumber or through plywood deck.

Metal Drip Edge: Minimum .024" pre-finished aluminum sheet, brake formed to provide 3" roof deck flange, and
1 - 1/2" fascia flange with 3/8" drip at lower edge. Furnish in 8' or 10' lengths.

Installation:

General: Comply with published recommendations of shingle manufacturer details and recommendations of Steep Roofing section of NRCA Roofing and Waterproofing Manual for installation of underlayment and shingles, using number of nails and coursing of shingles in accordance with manufacturer's standards.

Final Adjustment: Replace any damaged shingles and remove shingle installation debris from site.

END OF SECTION 07 31 13

SECTION 07 46 00 - PREFORMED SIDING

Performance Requirements: Provide preformed panel systems which comply with performance requirements indicated.

Submittals: Submit manufacturer's product data describing preformed siding panels and structural support system.

Submit samples of each exposed finish material.

Submit certification by manufacturer that products have been pretested and comply with performance requirements indicated.

Manufacturers: Provided the following or product meeting equal or better specifications.

Mastic Corp., T.Lok Vinyl Siding, Quad 2 1/2" and vented soffit.

Metal siding: 29 gauge wall panels, 26 gauge ceiling panels. Panels to be by Quality Edge or approved equal.

Color: Color to be selected. Submit standard samples to architect for approval.

Finish: Manufacturers standard.

Warranty: Manufacturers standard 50 year limited warranty.

Accessories: Provide manufacturer's standard and accessories as required for a complete installation including trim, flashing, corner units, clips, seam closures, battens, sealants, and similar items.

Comply with panel mfr.'s. instructions for anchorage, joint sealers, flashing and trim for the proper and permanent installation of panels, with provisions for thermal expansion, erected in panel pattern indicated.

Conceal fasteners by use of laps and joint clips.

END OF SECTION 07 46 00

SECTION 07 65 00 - FLASHING AND SHEET METAL

General:
Conform to profiles and sizes shown on drawings, and comply with “Architectural Sheet Metal Manual” by SMACNA, for each general category of work required. Material provided under this section must be compatible with Flexible Sheet Roofing material and be installed by Roofing Installer. If the Roofing Material Manufacturer provides materials compatible with roofing to allow homogenous bonding of associated materials, those materials may supersede the requirements of this section.

Metal flashing and counter flashing.
Metal wall flashing and expansion joints.
Exposed metal trim.
Sheet metal expansion joints.
Elastic sheet flashing.
Miscellaneous sheet metal accessories.

Products:

Aluminum Sheet: ASTM B 209, alloy 3003-H-14; 0.032 inch (20 gage); brown finish.

Fabricate sheet metal with flat-lock seams, except seal aluminum seams with epoxy metal seam cement and, where required for strength, rivet seams and joints.

Coat back-side of fabricated sheet metal with 15-mil sulfur-free bituminous coating, SSPC-Paint 12, where required to separate metals from corrosive substrates, including cementitious materials, wood or other absorbent materials; or provide other permanent separation.

Provide for thermal expansion of running sheet metal work by overlaps of expansion joints in fabricated work. Where required for water-tight construction, provide hooked flanges filled with polyisobutylene mastic for 1-inch embedment of flanges. Space joints at intervals of not more than 30 feet for zinc alloy or aluminum. Conceal expansion provisions where possible.

Extruded Aluminum Trim and Flashing: Provide standard products conforming to the profiles and sizes indicated, alloy 6063-T52, 0.08 inch minimum thickness’ complete with welded corner units, flashings and accessories.

Finish: AA C22A41 clear anodized.

Separate aluminum from contact with cementitious and absorptive surfaces, and from dissimilar metals, by a 15-mil coating of bituminous mastic (SSPC - Paint 12) or other permanent separation.

Bed base units in roofing cement. FS-SS-C-153/

Elastic Sheet Flashing/Membrane: Manufacturer’s standard flexible, elastic, black, non-reinforced, flashing sheet of 50 to 60 mils thickness, 50 to 70 Shore A hardness, 1200 psi tensile strength, minus 30 deg F (minus 35 deg C) brittleness.

Elastic Sheet: EPDM synthetic rubber.

Execution:

Anchor work in place with noncorrosive fasteners, adhesives, setting compounds, tapes and other materials and devises as recommended by manufacturer of each material or system. Provide for thermal expansion and building movements. Comply with recommendations of “Architectural Sheet Metal Manual” by SMACNA.

Seal moving joints in metal work with elastomeric joint sealants, complying with FS SS-T-00227, 00230, or 001543.

Clean metal surfaces of soldering flux and other substances which could cause corrosion.

Composition Stripping: Cover flanges (edges) of work set on bituminous substrate with 2 courses of glass fiber fabric (ASTM D-1668) set in and covered with asphaltic roofing cement, FS-SS-C-153.

Performance: Water-tight and weatherproof performance of flashing sheet metal work is required.

END OF SECTION 07 65 00

SECTION 07 90 00 - JOINT SEALERS

Materials, General:

Color: Manufacturer's standard highest-performance color, as selected by architect.

Compatibility: Provide materials selected for compatibility with each other and with substrates in each joint system; confirm with manufacturer.

General Characteristics: Provide type, grade, class, hardness and similar characteristics for material as indicated or, where not indicated, to comply with manufacturer's recommendations relative to exposures, traffic, weather conditions and other factors of the joint system for best possible overall performance. Except as otherwise indicated, joint sealers are required to permanently maintain airtight and waterproof seals, without failures in joint movement accommodation cohesion, adhesion (where applicable), migration, staining, and other performances as specified.

Elastomeric Sealants:

General: Provide sealant for all exterior location where sealants are required, but not called out or specified as to type.

Multi-Component Polyurethane Sealant: FS TT-S-00230C Class A; self-; leveling, except non-sag where joints are not horizontal.

Provide sealant in all exterior joints and joints between dissimilar materials where called for, and including:

Control and expansion joints (interior and exterior on exterior walls).
Joints between dissimilar materials (interior and exterior for doors, windows, etc.). Perimeter joints of exterior openings.
Under metal thresholds.

Non-Elastomeric Sealants and Caulking Compounds:

One-Component Acrylic Sealant: ASTM C920 Type S, Class 12.5 Grade NS, or FS tt-S-00230 Class B, non- say: solvent based, solids 95% acrylic.

Provide sealant in all interior joints and joints between dissimilar materials where called for and including:

Control and expansion joints.
Joints between dissimilar materials (door frames/masonry).
Vertical control joints at exposed surfaces of interior unit masonry.

Joint Sealants for Concrete Tanks:

Joint sealants to be used on tanks that will contain wastewater shall be polyurethane elastoer, as per ACO 504R. Polysufide sealants shall not be used.

Polyurethane sealant manufacturer shall certify that sealant is suitable for outdoor use in contact with municipal wastewater. Install per manufacturers recommendation.

Joint Fillers and Sealant Backers:

Expanded Polyethylene Joint Filler : Flexible, close-cell, 10 psi compression for 25% deflection, except higher if required for installation forces, 0.1 lbs. per. sq. ft. surface water absorption.

Sealant Backer Rod: Non-absorptive close-cell (or jacketed open-cell) compressible/flexible plastic or rubber rod stock neoprene, polyurethane, PVC.

Installation:

Clean joint surfaces and prime or seal as recommended by sealant manufacturer.

Support sealants from back with construction as shown, or with joint filler or backer rod.

Install sealants to size and shape shown or, if not shown, with “hour glass” section profile and as follows:

Elastomeric Sealants, Non-Traffic Joints: Depth equal to 50% of normal joint width, but not more than 1/2” and not less than 1/4”.

Non-Elastomeric Sealants, Non-Traffic Joints: Depth in range of 75% to 125% of normal joint width.

Joint Sealant for Concrete Tanks:

1. Joint sealants to be used on concrete structures that will contain wastewater shall be polyurethane elastomer, as per ACI 504R. Polysulfide sealants shall not be used.

2. Polyurethane sealant manufacturer shall certify that sealant is suitable for outdoor use in contact with municipal wastewater.

3. Install per manufacturer’s recommendations.

END OF SECTION 07 90 00

SECTION 08 15 00 - FIBERGLASS REINFORCED PLASTIC DOORS AND FRAMES

GENERAL

DESCRIPTION

Work Includes: Fiberglass reinforced plastic doors and frames.

SUBMITTALS: Submit shop drawings and product data under provisions of Section 01300. Indicate frame configuration, anchor types and spacing, location of cutouts for hardware, reinforcement and finish. Indicate door elevations and internal reinforcement. Submit manufacturer's product literature, fabrication descriptions and installation instructions under provisions of Section 01300.

DELIVERY, STORAGE AND PROTECTION: Deliver, handle and store doors and frames at the job site in such a manner as to prevent damage. Doors shall not be received before the building is enclosed. Only remove cartons
upon arrival of doors at job site if cartons are wet or damaged. Doors shall be stored out of weather and/or extreme temperatures. The doors shall be stored in a vertical position on blocking, clear of the floor and with blocking between the doors to permit air circulation between the doors. All damaged or otherwise unsuitable doors and frames, when so ascertained, shall be immediately removed from the job site.

REGULATORY REQUIREMENTS: Fire-rated door and panel construction conforms to products tested under ASTM E152, UL10B & NFPA 252. Install door and panel assembly conforming to NFPA for fire-rated class, ANSI A117.1 specifications for handicap accessibility, ADA requirements, ANSI A151.1 Mod. Swing cycle test in excess of 1,000,000 cycles. Flame Spread: All FRP component parts, including the gelcoat finish, shall have a flame spread classification of 25 or less per ASTM E84 and shall be self extinguishing per ASTM D635 unless operating conditions dictate otherwise. Resins: Resins to meet with USDA and FDA standards for incidental food contact, if applicable to this project.

PRODUCTS

ACCEPTABLE MANUFACTURERS: Products manufactured by the following companies complying with these specifications will be acceptable: CORRIM Company, Oshkosh, Wisconsin 54901. Telephone (920) 231-2000, Fax (920) 231-2238. Products manufactured that have successfully completed ANSI A151.1 Mod. Swing Cycle test in excess of 1,000,000 cycles, with no failure of any design features of the door.

DOORS: Door Fabrication FRP (Fiberglass Reinforced Plastic) Face Sheets:

> Standard face sheets shall be manufactured using a corrosion resistant resin system with light stabilizing additives. The resin shall be reinforced with fiberglass, 40% by weight. Face sheets shall be 0.070" to 0.125" in thickness. Standard being 0.120". Total door thickness to be a nominal 1 ¾".

Finish: Standard gelcoat color to be gray or white. Special gelcoat color to be selected by the architect. 15 Mils thick coverage, ± 3 mils. Smooth, seamless finish

Internal Construction:

Core: Option B: Polyurethane Foam Core a 1 ½" thick rigid block of polyurethane shall be laminated to the exterior panels. The "R: factor shall be 11-12.

Stiles and Rails:

Stiles and rails shall be 1 ½" square pultruded fiberglass tubes. A polyester-based resin filled with ¼"

chopped glass strands and aerosol shall be used for reinforcements and corner blocks, tec. The bottom rail shall allow 1 ¼" of height alterability without loss of the panel's integrity. No metal or wood lumber reinforcements will be allowed.

Fire-rated openings to be the "Polyfire Series" furnished in strict compliance with UL testing, and in accordance with ASTM-E152/UL 10B.

Hardware Preparations:
Reinforcement Blocking: Lockset - non-swelling polymer blocking; Surface mounted hardware - non-swelling polymer blocker; Thru-bolted hardware - non-swelling polymer blocking

Mortise Hardware; Full mortise hinges - non-swelling polymer blocking; Mortise locksets - to suit template provided; Exit devices - to suit template provided. All doors shall be mortised and reinforced to allow application of hinges and locks, in accordance with hardware schedule and manufacturer's templates. The hinges shall be attached by using stainless steel wood screws. Pilot holes shall be in strict accordance to manufacturer's recommendations.

Astragals: Astragals for pairs of doors to be fabricated of stainless steel material of manufacturer's standard flat design, by finish hardware supplier.

FRAMES

Frame Fabrication FRP (Fiberglass Reinforced Plastic)

Jamb Depth: 5 ¾" standard. Refer to frame schedule for exact sizes.

Face Dimension: 2" standard. Headers available in 2" and 4".
Return: 1/2"
Stop: 5/8"
Rabbet: 1 15/16"
Corner Miter: Head and Jamb members shall be standard 45º miter, providing a neatly mitered corner connection, fabricated for Knocked Down (KD) field assembly.
Pultrusion: In compliance with pultrusion industry standards
Reinforcements and Braces/Supports: Corner Reinforcement: 4" x 4" x 5 3/8" x ¼" thick pultruded fiberglass angel. Attached to head bar at factory using stainless steel screws or suitable polymer rivets. Mortise Hinge Reinforcement: 1 ½" x 7 x ¼" thick polymer. Attached to frame by means of bonding and stainless steel countersunk screws. Closer Reinforcement: Same as mortise hinge reinforcement, less screws. Strike Reinforcement: 1 ½" x 9 x ¾" thick polymer material. Attached to frame by means of bonding and stainless steel countersunk screws or suitable polymer rivets.

Anchoring Systems
"T"-Strap or Wire Anchor for masonry construction
Concealed existing wall anchor if necessary
Finish
Gelcoat: 15 mils thick, ± 3 mils on all exposed surfaces. Color to match door unless otherwise indicated.

FABRICATION

Fabricate FRP doors and frames as shown on the drawings and in accordance with best shop practices. Frames shall be rigid, neat in appearance and free from defects. Field measurements shall be taken as required for coordination with adjoining work.

Form exposed surfaces free from warp, wave and buckle, with all corners square, unless otherwise

shown. Set each member in proper alignment and relationship to other members with all surfaces straight and in a true plane.

Reinforce members and joints with plates, tubes or angels for rigidity and strength.

Doors and frames shall be mortised and reinforced for hardware in accordance with the hardware manufacturer's instructions and templates. The reinforcing shall be designed to receive hinges, locks, strikes, closures, etc.

Furnish at least three (3) metal anchors or polymer spacers in each jamb of frames up to 84" high and one (1) additional anchor for each 24" in height above 84", in shapes, sizes and spacing shown or required for anchorage into adjoining wall construction. Fabricate joint anchor of stainless steel.

Terminate bottom of frames at the indicated finished floor level.

Provide clearance for doors of 1/8" at jambs and heads; ¼" clearance above threshold.

INSPECTION

Installer shall examine the substrate and conditions under which fiberglass reinforced plastic work is to be installed and notify the General Contractor in writing of any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the installer.

INSTALLATION

General: Install FRP doors, frames and accessories in accordance with final shop drawings, NFPA 80 standards at fire-rated openings, and as herein specified. Installation to be similar to that of hollow metal doors and frames, and in accordance with FRP manufacturer's written instructions

Frame Installation: Place frames prior to construction of enclosing walls and ceilings. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders leaving surfaces smooth and undamaged. Frame must not be drilled for brace supports as finish may be damaged. In masonry construction, locate three (3) wall anchors per jamb at hinge and strike levels. Frames may be grouted full of mortar at jambs and anchors shall be built into the joints as walls are laid up. A continuous bead of silicone sealant is to be applied between the head and jamb at the miter joint.

Door Installation: Fit FRP doors accurately in frames, within clearances specified in Paragraph 2.04H of this section.

TOLERANCES

Maximum Diagonal Distortion: 1/8" measured with a straight edge, corner to corner. Maximum measurable plane is 4' 0" x 7' 0".

ADJUSTING

At substantial completion, adjust all operable components to ensure proper installation and that they function smooth and freely.

CLEANING

Remove dirt and excess sealant from exposed surfaces. Follow the manufacturer's recommended cleaning techniques and procedures for cleaning all surfaces. Use only cleaning products that will not scratch or damage the surfaces, and are recommended by the manufacture. Remove debris from project site.

WARRANTY

To include one (1) year free from defects in materials and workmanship from date of shipment, and thirty (30) years from degradation or failure due to corrosion from date of shipment, provided that the structural integrity of the doors and frames have not been violated or compromised. (No unauthorized cuts, bores, or other structural alterations affecting the core of the door, or the structure of the frame.) Normal wear and tear, or physical abuse of a specific installation is not part of this warranty.

END OF SECTION 08 15 00

SECTION 08 30 00 - ACCESS DOORS

Submittals: Manufacturer's standard details and specifications.

Manufacturers: the following (or equal):

Cesco Products

Frames: 12 ga. steel, factory primed.

Fabricate frame with exposed flange approximately 1" wide for access doors located in he following construction:

Style MS-W (medium security) for masonry wall.

Flush Panel Door: Factory primed 10 gauge galvanized steel or heavier with manufacturers standard hinges, provide lock (to be keyed by hardware supplier).

Installation: Coordinate installation with work of other trades and located accurately. Comply with manufacturer's instructions for secure attachment, proper relation to adjacent finished surfaces and proper operation.

END OF SECTION 08 30 00

SECTION 08 36 00 - OVERHEAD DOORS

Submittals: Manufacture's product data installation instruction.

Sectional Overhead Doors:

Provide complete operating door assemblies including frames, sections, brackets, guides, tracks, counterbalance, hardware, operators, and installation accessories.

Tracks, Supports, and Accessories: Manufacturer's standard galvanized steel, sized for door weight and dimensions, complete with ball-bearing roller guides, brackets, bracing and reinforcing. Provide continuous rubber or neoprene weather-stripping at top and bottom of each door.

Hardware: Manufacturer's standard, to suit size and type of door. Provide lifting handles, cremone type locking bars operable from inside and outside with chromium-plated operating handle and cylinder lock.

Counterbalance: Manufacturer's standard extension spring mechanism.

Installation: Set door, track and operation equipment complete with necessary hardware, jamb and head mold stops, anchors, insert, hangar and equipment supports in accordance with manufacturer's installation instructions.

Manual Door Operators: Provide except where electric operators are indicated. When not shown, provide chain hoist operator unit.

Push-up Operators: designed in counterbalance mechanism requiring not more than 25 lbs. lift or pull. Curtain stoppable and remain in position at any point of travel until movement reactivated.

Installation: Set door and operating equipment complete with necessary hardware, jamb and head mold stops, anchors, inserts, installation instructions.

END OF SECTION 08 36 00

SECTION 08 56 00 - FIBERGLASS WINDOWS

GENERAL

RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 specification Sections, apply to this section.

SUMMARY

This Section includes the following window types:

Sliding Window Units.

Performance Grade Classification: Provide wood windows that comply with requirements of NWWDA I.S. 2 for performance grade 40. Glass to be bronze, low E unit.

Performance Requirements (Grande 40 Windows): Each required window unit shall comply with the following performance requirements:

Air Infiltration: Not more than 0.25 cfm. per sq. ft. of overall frame area at an inward test pressure of 1.57 lbf per sq. ft.

Water Penetration: No water penetration as defined in the test method at an inward test pressure of 4.43 lbf per sq. ft.

Structural Performance: No glass breakage, damage to hardware, or permanent deformation that would impair operation of the unit, or residual deflection greater than 0.4 percent of the span at a positive (inward) and negative (outward) test pressure of 40 lbf per sq. ft.

Product certificates signed by the window manufacturer certifying that window units comply with specified performance requirements.

Safety Glass Standard: Where safety glass is indicated or required by authorities having jurisdiction, provide the type of products indicated which comply with ANSI Z97.1 and testing requirements of 16 CFR Part 1201 for category II materials.

Single Source Responsibility: Provide fiberglass windows produced by a single fabricator who is capable of indicating prior successful production of units similar to those required.

Design Criteria: Drawings indicate window sizes, profiles, and dimensional requirements. Window units having minor deviations from indicated dimensions and profiles may be accepted, subject to the Architect's approval, provided such deviations do not materially detract from the design concept or intended performance.

Warranty
Submit a written warranty signed by the Manufacturer, agreeing to repair or replace fiberglass window units that fail in materials or workmanship with the specified warranty period.

Fiberglass Window Units:

Pella or approved equal.

MATERIALS

General: Comply with requirements of NWWDA I.S. 2.

Insect Screens: Provide removable insect screen panel for each movable glazed sash. Comply with requirements of SMA 2005.

INSTALLATION

Comply with manufacturer's instructions and recommendations for installation of window units, hardware, operators, accessories, and other window components.

Set units plum, level, true to line, without warp or rack of frames or sash. Provide proper support and anchor securely in place.

Set sill members in a bed of compound or with joint fillers or gaskets as indicated, to provide weathertight construction. Refer to Division 7 sections for joint fillers and sealants required to be installed concurrently with window units. Coordinate window installation with wall flashings and other built-in components.

ADJUSTING

Adjust operating sash and hardware to provide a tight fit at contact points and weather-stripping, and to provide smooth operation and a weathertight closure. Lubricate hardware and moving parts.

CLEANING

Clean interior and exterior surfaces promptly after installation of windows. Take care to avoid damage to protective coatings and finishes. Remove excess glazing and sealants, dirt, and other substances.

Clean glass of pre-glazed window units promptly after installation. Wash and polish glass on both faces not more than 4 days prior to date scheduled for final inspection. Comply with manufacturer's recommendations for final cleaning and maintenance.

Remove and replace glass that is broken, chipped, cracked, abraded or damaged in other ways during construction period, including natural causes, accidents, and vandalism.

PROTECTION

Institute and maintain protection and other precautions required through remainder of construction period to ensure that, except for normal weathering, window units will be without damage or deterioration at the time of substantial completion.

END OF SECTION 08 56 00

SECTION 08 70 00 BUILDERS HARDWARE

Description of work:
The extent of builders hardware is shown on the Drawing in schedules. Builders hardware is hereby defined to include all items known commercially as builders hardware, as required for swing and sliding doors, except special typed of unique and non-matching hardware specified in the same section as the door and door frame.

Quality Assurance

Acceptable Hardware Manufacturers:

General:

Listed herein are acceptable manufacturers for the primary items of builders hardware. Listed manufacturer's products which comply with the indicated requirements are acceptable for other items.

An asterisk (*) indicates which manufacturer's product numbers have been used in schedules and elsewhere to
establish minimum requirements.

Obtain each kind of hardware (latch and lock sets, hinges, closures, etc.) from only one manufacturer, even though several may be indicated as acceptable manufacturers.

Listing of Acceptable Manufacturers:

A. Hinges.....McKinney, *Hager, *Stanley
B. Locksets & Latchsets.....Yale, Schlage, Sargent, *Cal Royal
D. Door Closures.....*LCN, *Norton, Sargent, Yale, Rixon
E. Pulls.....*Rockwood, Trimco, Ives, Hiawatha
F. Flushbolts.....*Rockwood, Glynn Johnson, Ives
G. Stops.....*Rockwood, Ives, Quality
H. Thresholds.....*National Guard, Pemko, Reese
I. Weatherstrip & Sweeps.....*National Guard, Pemko, Reese

Any substitute of a product not listed, without prior written approval, will be rejected.

Supplier:

A recognized builders hardware supplier who has been furnishing hardware in the same area of the project for a period of time of not less than two years, and who is, or has in employment, an experienced hardware consultant who is available at reasonable times during the course of work for project hardware consultation to the Owner, Architect and Contractor.

Installer:

Assign installation of hardware to experienced tradesmen, either at the door and frame fabrication plant or at the
project site.

Departures from Scheduled Designations:

Except as otherwise indicated, the use of one manufacturer's numeric designation system in schedules does not imply that other listed acceptable manufacturer's products will not be acceptable, unless they are not acceptable in design, or not equal in size, weight, finish, function, or other quality of significance. Do not change the selection after Architect's acceptance of hardware supplier's completed hardware schedule.

Fire-Rated Openings:

Provide hardware in compliance with NFPA Standard No. 80. Provide only U.L. tested and listed hardware.

Where emergency exit devices are required on fire-rated doors, (with supplementary marking on door UL label indicating "fire Door to be Equipped with Fire Exit Hardware") provide UL label on exit device indicating "Fire Exit Hardware".

Submittal

Manufacturer's Data

Submit manufacturer's product data for each item of hardware. Include whatever information may be necessary to show compliance with requirements, and include instructions for installation and for maintenance of operating parts and exposed finishes. Whenever needed, furnish templates to fabricators of other work which is to receive finish hardware.

Samples:

Prior to submittal of the final hardware schedule and prior to delivery of hardware, submit one sample each exposed hardware unit, finished as required and tagged with full description for coordination with schedule. Sample will be reviewed by Architect for design, color, and texture only. Compliance with other requirements is the exclusive responsibility of the Contractor. Samples will be returned to supplier. Units which are acceptable and remain undamaged through submittal, review and operation, may be use in work, within limitations of keying coordination requirements.

HARDWARE SCHEDULE:

General:

Submit six (6) copies of the hardware schedule in the manner and format specified. Hardware schedules are intended for coordination of the work. Review and acceptance by the Architect or Owner does not relieve the Contractor of his exclusive responsibility to fulfill the requirements as shown and specified.

Include a separate key schedule, showing clearly how the Owner's final instruction on keying of locks have been fulfilled. Coordinate with existing keying system.

Hardware Schedule Format:

Submit hardware schedule in the same format (sets) as set forth in the specifications. Add additional information, such as door numbers, total quantities of each hardware item, etc., as may be deemed necessary for the Builder's hardware supplier.

Submit two (2) copies of catalog cuts of all hardware items proposed by listed acceptable manufacturers to be used in the project in lieu of each scheduled hardware item, including catalog cuts f the scheduled hardware item it is proposed to be substituted for.

Mark-up choices and options in data on both proposed and scheduled hardware catalog cut sheets, as necessary to indicate characteristic of the actual product being provided for the project.

JOB CONDITIONS

Coordinate hardware with other work. Tag each item or package separately, with identification related to the final hardware schedule, and include basic installation instructions in the package. Furnish hardware items of proper design for use on doors and frames of the thicknesses, profile, swing, security and similar requirements indicated, as necessary for proper installation and function. Deliver individually packaged hardware items at the proper times to the proper locations (shop or project site) for installation.

Keying:

All locks and cylinders shall be keyed alike in sets and maser keyed at the direction of the Owner.

Furnish six (6) master keys and two (2) keys each lock, unless otherwise noted.

Miscellaneous Items:

Door Stripping:

Provide type indicated or, if not indicated, type recommended by manufacturer for condition of exposure, with easily replaceable resilient stripping elements.

On fire-rated doors provide type approved for use with rating.

Provide weatherstripping at jambs and head of each exterior door.

Provide weatherstripping at sill of each exterior door, threshold-contact type except as otherwise indicated.

All weatherstripping and sweep strips to be supplied with self-drilling “tek” screws for installation on hollow metal doors and frames.

EXECUTION

INSTALLATION

General:

Install each hardware item in compliance with manufacturers’ instructions and recommendations. Wherever cutting and fitting is required to install hardware onto or into surfaces which are later to be painted or finished in another way, coordinated removal, storage, and reinstallation or application of surface projections with finishing work specified in Section 09 90 00. Do not install surface-mounted items, including silencers, until finishes have been completed on the substrate.

Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.

Drill and countersink units which are not factory-prepared for anchorage fasteners.
Space fasteners. Space fasteners and anchors in accordance with industry standards.

Mounting heights:

Mount hardware units at heights indicated in “Recommended Locations for Builders

Hardware" by the Door and Hardware Institute (DHI), except as otherwise specifically indicated or required to comply with governing regulations.

Thresholds and Floor Covers:

Cut and fit to profile of door frames, with mitered corners and hairline joints.

Screw to substrate with No. 10 or larger screws, of the proper type for permanent anchorage and of bronze, stainless steel, or other materials which will not corrode in contact with the threshold metal.

At exterior doors, and elsewhere as indicated, set each edge of threshold in a seal strip of sealant. Remove excess sealant. See section 07 90 00 for type sealants required.

ADJUST AND CLEAN

General:

Hardware supplier shall, at completion of hardware installation, visit jobsite and adjust and check each operating item of hardware and each door to ensure proper operation or function of every unit. Lubricate moving parts with type lubricant recommended by builders hardware manufacturer. Replace units which cannot be adjusted or lubricated to operate freely and smoothly as intended for the application made. Adjust door control devices to compensate for final operation of heating ventilating equipment. Hardware supplier shall notify Architect, in writing, as to any major hardware misinstallations and that adjustments have been made.

END OF SECTION 08 70 00

SECTION 09 90 00

PAINTING

Submittals: In addition to manufacturer's data, application instructions, and label analysis for each coating material, submit samples if requested until required sheen, color and texture is achieved. Resubmit samples until required sheen, color and texture is achieved.

Description of Work: Painting and finishing of interior and exterior items and surfaces, unless otherwise indicated.

Paint all exposed surfaces, except as otherwise indicated, whether or not colors are designated. If not designated, colors will be selected by the OWNER from standard colors available for the coatings required.

Work not Included: Unless otherwise indicated, shop priming of ferrous metal items and fabricated components are included under their respective trades. Pre-finished items, such as metal toilet partitions, acoustic material and the like, are not included. Unless otherwise indicated, painting not required on surfaces of concealed areas except for piping, equipment and other such items within the concealed spaces. Finished metals such as anodized aluminum, stainless steel, bronze, and similar metals will not be painted. Do not paint any moving parts of operating units, or over any equipment identification, performance rating, name or nomenclature plates or code-required labels.

Delivery and Storage: Deliver materials to job site in new original, and unopened containers bearing manufacturer's name, trade name, and label analysis. Store where indicated in accordance with manufacturer's instructions.

Protection: Protect work of other trades. correct any painting related damages by cleaning, repairing or replacing, and refinishing, as directed by OWNER.

Coordination: Provide finish coats which are compatible with prime paints used. Provide barrier coats over incompatible primers where required. Notify the OWNER in writing of anticipated problems using specified coatings with substrates primed by others.

Surface Preparation: Perform preparation and cleaning procedure in strict accordance with coating manufacturer's instructions for each substrate condition.

Remove hardware and accessories, machined surfaces, plates, lighting fixtures and similar items in place and not to be finished-painted or provide surface-applied protection. Reinstall removed items.

Seal wood required to be job-painted. Prime edges, ends, face, underside and backsides of counters, cases, cabinets, counters, etc. Use spare varnish for backpriming where transparent finish is required.

Backprime interior paneling only where masonry, plaster, or other wet wall construction occurs on backside.

Seal tops, bottoms, and cut-outs of wood doors with heavy coat of varnish or similar sealer immediately upon deliver to job.

Material Preparation: Mix, prepare, and store painting and finishing materials in accordance with manufacturer's directions.

Application: Apply painting and finishing materials in accordance with the manufacturer's directions. Use applicators, and techniques best suited for the material and surfaces to which applied.

Apply additional coats when undercoats, stains or other conditions show through final paint coat, until paint film is of uniform finish, color and appearance.

Paint surfaces behind moveable equipment and furniture same as similar exposed surfaces. Paint surfaces behind permanently fixed equipment or furniture with prime coat only before equipment is installed.

Paint interior surfaces of ducts, where visible through registers or grilles, flat, non-specular black.

Paint back sides of access panels, and removable or hinged covers to match exposed surfaces.

Finish exterior doors on tops, bottoms and edges same as exterior faces, unless otherwise indicated.

Sand lightly behind succeeding enamel or varnish coats.

Omit first coat (primer) on metal surfaces which have been shop-primed and touch-up painted, unless otherwise specified.

Apply primed coat to material which is required to be painted or finished, and which has not been prime coated by others.

Apply each material at not less than the manufacturer's recommended spreading rate, to provide a total dry film to thickness of not less than 4.0 mils for the entire coating system of prime and finish coats for 3-coat work.

Completed Work: Match approved samples for color, texture and coverage. Remove, refinish or repaint work not in compliance with specified requirements.

EXTERIOR PAINT SYSTEMS (EPS)

System EPS-2A; Semi-Gloss Alkyd Enamel:

1st Coat; (Primer):

Ferrous Metal: Red lead pigmented primer (TT-P-86, Type III).
Galvanized Metal: Zinc dust-zinc oxide primer (TT-P-641).

2 Coat and 3rd Coat:

Alkyd Enamel, Semi-Gloss (TT-E-489F, Class A).

Apply to the following exterior surfaces:

hollow metal doors and frames
lintels exposed to weather.
miscellaneous metal items.
exposed structural steel.
exposed piping.

INTERIOR PAINT SYSTEMS (IPS)

System IPS-2A; Semi-Gloss Enamel:

1st Coat; (Primer):

a. Ferrous Metal: Red lead primer (TT-P-86).
b. Galvanized Metal: Zinc dust-zinc oxide primer (TT-P-641).
c. Gypsum Drywall: (TT-P-650).
d. Concrete Masonry Units: Surface filler (TT-F-1098).

2nd Coat:

a. Ferrous Metal and Galvanized Metal: Enamel Undercoater (TT-E-543).
b. Gypsum Drywall: (TT-E-509).
c. Concrete Masonry Units: Undercoat (TT-E-543).

3rd coat:

a. Odorless alkyd Enamel, Semi-Gloss (TT-E-509).

Apply to the following scheduled interior surfaces:

hollow metal doors and frames except those scheduled to receive paint system EPS-2A.
gypsum drywall walls.
CMU walls.
Iron Pipe and Valves

System IPS -2B; Eggshell Enamel:

1st Coat; (primer):

Gypsum Drywall: Latex Primer (TT-P-650).

Wood: Enamel Undercoater (TT-E-543).

2nd Coat:

Gypsum Drywall and Wood: Latex Enamel, Eggshell (TT-P-1511A).

3rd Coat:

Synthetic Enamel, Eggshell (TT-E-529).

Apply to the following scheduled interior surfaces:

Drywall ceilings not scheduled to receive other applied finishes.

Exterior Painting of Process Equipment

Work Included:

Work includes painting of all ferrous metals on wastewater treatment plant process units, including but not necessarily limited to the following items. In general, all ferrous metal (including galvanized) will be painted unless it is buried pipe.

- all structural steel bridges, decks, and stairways.
- all exposed metal machinery, control boxes, etc.
- miscellaneous metal hangers, supports, etc.

Specifically excluded from these painting requirements are:
- all aluminum handrails, grating and stair treads

- any machinery that come prefinished from the factory
- glass-coated steel tanks

Exterior work included in previous articles of this section:
- all exterior painting of the service building and its appurtenances
- steel light poles

PERFORMANCE OF WORK

All work shall be conducted as detailed in prior articles of the section, with the exception that the paint systems used shall as detailed in Article 2.03.

PART 2 - EXTERIOR PAINTING OF PROCESS EQUIPMENT

2.01 WORK INCLUDED:

A. Work includes painting of all ferrous metals on wastewater treatment process units, including but not necessarily limited to the following items. In general, all ferrous metal (including galvanized) will be painted unless it is buried pipe.
- all structural steel bridges, decks, and stairways.
- all exposed metal machinery, control boxes, etc.
- miscellaneous metal hangers, supports, etc.

B. Specifically excluded from these painting requirements are:
- all aluminum handrails, grating, and stair treads.
- any machinery that comes prefinished from the factory.

2.02 PERFORMANCE OF WORK

All work shall be conducted as detailed in prior articles of this section, with the exception that the paint systems used shall be as detailed in Article 2.03.

2.03 PAINT SYSTEMS FOR EXTERIOR PROCESS UNITS

A. Materials
1. All materials specified herein are manufactured by the Tnemec Company, Inc., North Kansas City, Missouri and are approved for use of this project.
2. Equivalent materials of other manufacturers may be substituted on approval of the engineer. Requests for substitution shall include manufacturer's literature for each product giving the name, generic type, descriptive information, solids by volume, recommended dry film thickness and a list of 10 projects where each product has been used and rendered satisfactory service for at least 3 years. No request for substitution shall be considered that would decrease film thickness and/or number of coats or offers a change in the general type of coating specified.
3. Colors, where not specified, shall be as selected by the engineer.

B. Application:
1. Materials shall be mixed, thinned and applied according to the manufacturer's printed instructions.
2. Allow each coat to dry thoroughly before applying the next coat.
3. All work shall be cut in neatly and finish coats shall be uniform in color and texture without streaks, laps, heavy build-ups, runs, sags, or missed areas.

C. Acceptance of work:
1. Request acceptance of each coat before applying the next coat.
2. Correct work that is not acceptable and request reinspection.

D. Painting schedule:
(all thicknesses for dry film)

1. Steel - structural, pipes, equipment, etc.

a. Exterior, non immersion; factory-primed with #66-1211 primer (3.0 to 4.0 mils)
- Series 73 Endura-Shield III Acrylic Polyurethane Enamel
- Surface preparation: SSPC-SP6
- Factory prime coat: 66-1211 Hi-build Epoxoline (3.0 to 4.0 mils)
- Field coats:

Intermediate:	66-color Hi-build Epoxoline	(2.0 to 3.0 mils)
Final:	73-color Endura-Shield III	(2.0 to 3.0 mils)
Total		(7.0 to 10.0 mils)

b. Exterior; non-immersion:
- Series 73 Endura-Shield III Acrylic Polyurethane Enamel
- Surface preparation: see manufacturer's recommendations for various surfaces.
- Field coats:

1st coat:	66-color Hi-build Epoxoline	(4.0 to 6.0 mils)
2nd coat:	73-color Endura-Shield III	(2.0 to 3.0 mils)
Total		(6.0 to 9.0 mils)

c. Exterior; immersion or intermittent immersion
- Series 46H-413 Hi-build TNEME-TAR coal tar-epoxy
- Surface preparation: see manufacturer's recommendations for various surfaces.

1st coat:	46H-413 Coal tar-epoxy	(14.0 to 20.0 mils)
Total		(14.0 to 20.0 mils)

2.04 PAINT SYSTEMS FOR CHEMICAL CONTAINMENT AREA

NOT USED

END OF SECTION

SECTION 10 00 00 - PORTABLE FIRE EXTINGUISHER

Extinguisher Manufacturers: Provide products by the following:

Kidde Belleville, Div. of Walter Kidde & Comp. Inc.

Fire Extinguisher Standard: Provide units which comply with applicable UL standard and are labeled by UL.

Submittals: Submit product data and installation instructions.

Fire Extinguisher (FE): provide fire extinguisher unit of types indicate for locations indicated.

Multi-Purpose Dry Chemical Type (2A-10BC-FE): UL-rated 2-A, 10-BC, 5lb. nominal capacity, in enameled steel container.

Mounting Brackets: Manufacturer's standard, of proper size for type and capacity of extinguisher indicated. Provide brackets for extinguisher.

Installation: In accordance with manufacturer's directions for type of mounting required at height and locations indicated, or if not indicated, to comply with applicable regulations governing authorities.

Identify bracket-mounted extinguisher with red letter decals spelling "FIRE EXTINGUISHER" applied to wall surface. Letter size, style and location selected by Architect.

END OF SECTION 10 00 00

SECTION 10 14 00

SIGNAGE

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work included:
1. Furnishing and installation of all safety and informational signs and identification devices.
2. Safety and hazardous chemical signs
3. Pipe identification and labeling.

B. Related sections:
1. Section 01 20 00 - PRICE AND PAYMENT PROCEDURE
2. Section 01 33 00 - SUBMITTAL PROCEDURES

1.02 SUBMITTALS

A. Make all submittals in accordance with Section 01 33 00 - SUBMITTAL PROCEDURES

B. Submit samples and proposed wording for all signs prior to ordering signs and identifying devices.

C. Provide the following samples of each sign:
1. Initial selection of color, pattern, and texture:
   a. Cast Acrylic Sheet and Plastic Laminate: Manufacturer's color charts consisting of actual sections of material including the full range of colors available for each material required.
2. Verification of color, pattern, and texture selected:
   a. Cast Acrylic Sheet and Plastic Laminate:
      i. Sample panel size: 8-1/2 inches by 11 inches minimum.
      ii. Include a panel for each color, texture, and pattern required.
      iii. On each panel include a representative sample of the graphic image process required, showing graphic style, and colors and finishes of letters, numbers, and other graphic devices.

1.03 QUALITY ASSURANCE

Obtain all signs from one manufacturer.

1.04 PRODUCT HANDLING

Protect from damage during handling, installation, and subsequent construction activity. Repairs and/or replacement due to damage will be the responsibility of the contractor

PART 2 - PRODUCTS

2.01 SAFETY AND HAZARDOUS CHEMICAL SIGNS

A. Meet all applicable OSHA requirements as to size, colors, wording, and design.

B. Design requirements:
   1. Size: 10" x 14" approx.
   2. Fiberglass (Direct Safety Company, or equal), or other weatherproof material suitable for exterior mounting.

C. Location and suggested wording: Exact wording of signs may vary with prior approval of the Engineer.
   1. Wording: "Non-potable Water DO NOT DRINK"
      Location: All hose bibs and fixtures.
   2. Wording: "CAUTION FLOOR SLIPPERY WHEN WET"
      Location: Near each door entering:
      Headworks Building
   3. Wording: "DANGER - EXPLOSIVE GAS - NO SMOKING"
      Location: Near each door entering the Headworks building
   4. Wording: "CAUTION - EQUIPMENT STARTS AUTOMATICALLY"
      Location: One for each of the following pieces of equipment
      Mechanical Bar Screen
      Blowers
   5. Wording: "EXIT"
      Location: Above all doors to the outside

D. 1. Signs: Mount flush on walls, doors, or control panels.
   2. Yard hydrant signs: Mount on a rigid metal backing plate and u-bolt to the hydrant with stainless steel fasteners.

2.02 PIPE IDENTIFICATION

A. Pipe painting color schedule:
   1. Interior exposed ductile iron, galvanized steel, and black iron pipe.

a.	Sludge lines	brown
b.	Gas lines	orange
c.	Sewage lines	gray
d.	Compressed air lines	green
e.	Decant lines:	brown with yellow band
f.	Non-potable water:	blue with black band
g.	Potable water:	blue

   2. Exterior exposed pipe: Match the adjacent structure, with final color approval to be made by the Owner.

B. Pipe banding and labeling:
   1. General: Identify all accessible piping with colored band and labels at the following locations:
   2. Location:
      a. Adjacent to each valve.
      b. Each branch and riser at take-off.
      c. At each pipe passage through wall or floor.
      d. At not more than 25 feet spacing on straight pipe runs.
      e. At each change in direction.
      f. Aluminum Sulfate lines:
         i. 10 feet maximum band and label spacing
         ii. At least two per room.
   3. Identification Tags:

a. Use on pipes to small for band and label application.
b. Not less than 1-1/2 inch in diameter with depressed black figures 1/2 inch high.

4. Materials:
   a. Paint on the pipe or pipe covering, or
   b. Pressure sensitive tape pipe markers.
5. Labels:
   a. Upper case letters and Arabic numerals
   b. Provide arrows shall adjacent to labels to indicate the direction of flow under normal operating conditions.
6. Painted bands and labels:
   a. Two coats minimum
   b. Prime coat specified under 09 90 00 – PAINTING AND COATING
   c. Where piping is not required to receive general painting, a band prime coat followed by a finish coat shall be applied under this section.
   d. Piping with asphalt varnish: remove with solvent, or other means, for the extent of the required band dimensions.
   e. Apply labels and arrows over the bands with one or two coats of finish paint as required to obtain complete hiding.
   f. All prime and finish paint materials shall conform to applicable requirements of Section
      09900, except as specified under this section.
7. Pipe markers:
   a. Sizes, colors, and labels: same as specified for painted bands and labels.
   b. Provide cleaning or precovering materials necessary to insure permanent adhesion.
   c. Use markers from manufacturer that have been used successfully for 2 years minimum in similar application.
8. Color and sizing schedules:
   a. Table 1

Outside Diameter of Pipe or Pipe Covering	Minimum Width of Color Band	Size of Label Letters and Numerals
3/4" to 1-1/4"	3"	1/2"
1-1/2" to 2"	3"	3/4"
2-1/2" to 6"	3"	1-3/4"
8" and up	3"	2-1/2"

   b. Table 2

Pipe Control	Band Color	Label Color	Label Wording
Wastewater Sludge	None	*	Sludge
Raw Wastewater	None	*	Raw W.W.
Return Activated Sludge	None	*	R.A.S.
Waste Activated Sludge	None	*	W.A.S.
Compressed Air	None	*	Air
Natural Gas	Orange	*	Gas
Fuel Oil	Orange	*	Oil
Chlorine Solution	Yellow	*	CL2
Aluminum Sulfate Solution	Yellow	*	Al2SO4
Water			
Potable cold	Blue	*	CPW
Potable hot	Blue	*	HPW
Potable tempered	Green	*	TPW
Service water	Red	*	SW
Final Effluent Water	Red	*	FEW

* Label color must contrast with background. Use either black, white or band color.

c. The colors referred to in Table II shall be similar to the color ships in Federal Standard 595, as identified by number in the color schedule below. If the base paints do not match the color ships, they shall be mixed with the proper colors in oil to obtain matching required. All color matching shall be subject to approval.

COLOR SCHEDULE

Color	Number Fed. Std. 595
Red	11105
Yellow	13655
Black	17038
White	17875
Green	14260
Blue	15102
Orange	12473

END OF SECTION

SECTION 22 07 19
PLUMBING PIPING INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Piping insulation.

1.02 REFERENCE STANDARDS

A. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot Plate Apparatus; 2013.

B. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2013.

E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2014.

F. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2013.

G. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; National Fire Protection Association; 2006.

H. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

PART 2 PRODUCTS

2.01 REQUIREMENTS FOR ALL PRODUCTS OF THIS SECTION

A. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84, NFPA 255, or UL 723.

2.02 GLASS FIBER

A. Insulation: ASTM C547; rigid molded, noncombustible.
   1. 'K' ('Ksi') value: ASTM C177, 0.24 at 75 degrees F (0.035 at 24 degrees C).
   2. Maximum service temperature: 850 degrees F (454 degrees C).
   3. Maximum moisture absorption: 0.2 percent by volume.

B. Vapor Barrier Jacket: White Kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches (0.029 ng/Pa s m).

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that piping has been tested before applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards.

C. Exposed Piping: Locate insulation and cover seams in least visible locations.

3.03 SCHEDULES

A. Plumbing Systems:
   1. Domestic Hot and Cold Water Supply:
      a. Glass Fiber Insulation:
         1) Pipe Size Range: All sizes.
         2) Thickness: 1/2 inch.

END OF SECTION

SECTION 22 10 05
PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Pipe, pipe fittings, valves, and connections for piping systems.
   1. Sanitary sewer.
   2. Domestic water.

1.02 REFERENCE STANDARDS

A. ANSI Z21.22 - American National Standard for Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems; 1999, and addenda A&B (R2004).

B. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; The American Society of Mechanical Engineers; 2011.

C. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings; The American Society of Mechanical Engineers; 2013.

D. ASME B31.1 - Power Piping; The American Society of Mechanical Engineers; 2012 (ANSI/ASME B31.1).

E. ASME B31.9 - Building Services Piping; The American Society of Mechanical Engineers; 2014 (ANSI/ASME B31.9).

F. ASME BPVC-IV - Boiler and Pressure Vessel Code, Section IV - Rules for Construction of Heating Boilers; The American Society of Mechanical Engineers; 2013.

G. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.

H. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings; 2013a.

I. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2013.

J. ASTM B32 - Standard Specification for Solder Metal; 2008 (Reapproved 2014).

K. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2009.

L. ASTM D2239 - Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter; 2012.

M. ASTM D2447 - Standard Specification for Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, Based on Outside Diameter; 2003.

N. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40; 2013.

O. ASTM D2513 - Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings; 2014.

P. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems; 2012.

Q. ASTM D2609 - Standard Specification for Plastic Insert Fittings for Polyethylene (PE) Plastic Pipe; 2002 (Reapproved 2009).

R. ASTM D2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings; 2014.

S. ASTM D2683 - Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing; 2010.

T. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings; 1996 (Reapproved 2010).

U. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2014.

V. ASTM F876 - Standard Specification for Crosslinked Polyethylene (PEX) Tubing; 2013a.

W. ASTM F877 - Standard Specification for Crosslinked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution Systems; 2011.

X. ASTM F1281 - Standard Specification for Crosslinked Polyethylene/Aluminum/Crosslinked Polyethylene (PEX-AL-PEX) Pressure Pipe; 2011.

Y. AWWA C651 - Disinfecting Water Mains; American Water Works Association; 2005 (ANSI/AWWA C651).

Z. MSS SP-80 - Bronze Gate, Globe, Angle and Check Valves; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2013.

AA. MSS SP-85 - Cast Iron Globe & Angle Valves, Flanged and Threaded Ends; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2011.

AB. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2010.

AC. NFPA 54 - National Fuel Gas Code; National Fire Protection Association; 2012.

AD. NSF 61 - Drinking Water System Components - Health Effects; 2014.

AE. NSF 372 - Drinking Water System Components - Lead Content; 2011.

AF. PPI TR-4 - PPI Listing of Hydrostatic Design Basis (HDB), Hydrostatic Design Stress (HDS), Strength Design Basis (SDB), Pressure Design Basis (PDB), and Minimum Required Strength (MRS) Ratings For Thermoplastic Piping Materials or Pipe; Plastics Pipe Institute; 2013.

1.03 NOT USED

1.04 REGULATORY REQUIREMENTS

A. Perform Work in accordance with State of Michigan plumbing code.

B. Conform to applicable code for installation of backflow prevention devices.

C. Provide certificate of compliance from authority having jurisdiction indicating approval of installation of backflow prevention devices.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Potable Water Supply Systems: Provide piping, pipe fittings, and solder and flux (if used), that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.

2.02 SANITARY SEWER PIPING, BURIED WITHIN 5 FEET (1500 MM) OF BUILDING

A. PVC Pipe: ASTM D2665 or ASTM D3034.
   1. Fittings: PVC.
   2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.03 NOT USED

2.04 SANITARY SEWER PIPING, ABOVE GRADE

A. PVC Pipe: ASTM D2665.
   1. Fittings: PVC.
   2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.05 SANITARY VENT PIPING:

A. Cast Iron Service Weight ANSI A21.6 No-Hub Pipe and neoprene sleeve, stainless shield joints conforming to AISPI 01 and ASTM C564 to be used.

2.06 WATER PIPING, ABOVE GRADE

A. Piping shall be Copper Tubing ASTM B-88 Type L, hard drawn with wrought copper fittings and Grade 95TA solder joints.

2.09 BALL VALVES

A. Construction, 4 Inches (100 mm) and Smaller: MSS SP-110, Class 150, 400 psi (2760 kPa) CWP, bronze body, 304 stainless steel ball, regular port, teflon seats and stuffing box ring, blow-out proof stem, lever handle, solder ends with union.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that excavations are to required grade, dry, and not over-excavated.

3.02 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

D. Install piping to maintain headroom, conserve space, and not interfere with use of space.

E. Group piping whenever practical at common elevations.

F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 22 05 16.

G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 22 07 19.

H. Install valves with stems upright or horizontal, not inverted.

I. Install water piping to ASME B31.9.

J. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.

K. Sleeve pipes passing through partitions, walls and floors.

L. Pipe Hangers and Supports:
   1. Install in accordance with ASME B31.9.
   2. Support horizontal piping as scheduled.
   3. Install hangers to provide minimum 1/2 inch (15 mm) space between finished covering and adjacent work.
   4. Place hangers within 12 inches (300 mm) of each horizontal elbow.

3.04 APPLICATION

A. Install unions downstream of valves and at equipment or apparatus connections.

B. Install gate valves for shut-off and to isolate equipment, part of systems, or vertical risers.

3.05 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

B. Prior to starting work, verify system is complete, flushed and clean.

C. Ensure Ph of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).

D. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.

E. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.

F. Maintain disinfectant in system for 24 hours.

G. If final disinfectant residual tests less than 25 mg/L, repeat treatment.

H. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.

I. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

END OF SECTION

SECTION 23 00 00
MECHANICAL GENERAL PROVISIONS

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. This Division includes all materials, labor, equipment, tools, supervision, permits, and incidentals necessary to complete installation and successfully test, start-up, and operate, in a practical and efficient manner, all mechanical systems indicated on the Mechanical Drawings and described in this Division. The work shall also include any items which, while not specifically included in the Contract Documents, are reasonable and are accepted trade practices or necessary for the proper completion of the systems.

B. Mechanical systems in the contract shall include the following:
   1. Plumbing systems including:
      a. Domestic potable hot water, cold water, and sanitary drain systems.
      b. Plumbing fixtures, piping, and insulation indicated in the Drawings and Specifications.
   2. Heating, ventilation, and air-conditioning (HVAC) systems including all equipment ductwork, piping, insulation, and temperature control systems indicated in the Drawings and the Specifications.

C. The General Provisions of this Contract, including General and Supplementary Conditions and other General Requirements specified in the Architectural, Electrical, Structural, and Fire Protection Specifications apply to the work specified in this Section.

D. This section is not intended to supersede, but to clarify the definitions in Division 01, General Requirements.

1.02 DRAWINGS AND SPECIFICATIONS

A. Drawings are diagrammatic and are intended to convey a general arrangement and scope of the work included in the contract. Should drawings contradict themselves or the Specifications, the better quality or greater quantity of work shall be included.

B. The Mechanical Contractor shall be familiar with all Architectural, Structural, Fire Protection, and Electrical Drawings and Specification Sections, and shall follow any special requirements or directions included in these areas.

C. Drawings and Specifications are intended to include all work and materials necessary for completion of the work. Any incidental item of material, labor or detail required for the proper execution and completion of the work and omitted from either the drawings and specifications or both, but required by governing codes local regulations, trade practices, operational functions, and good workmanship, shall be provided as part of the Contract Work without extra charge, even though not specifically detailed or specified.

D. Should there be any question as to the scope of work for which the Mechanical Contractor is responsible, they should request an interpretation before submitting their bid. After contracts are awarded, the Owner shall not be responsible for claims for extras for work that was not included because the Mechanical Contractor was unsure if they should include given work in their bid.

1.03 SITE AND PROJECT DOCUMENT EXAMINATION

A. Submission of a bid proposal is considered evidence that the Mechanical Contractor has completed the following:
   1. Visited the site.
   2. Informed themselves of the site conditions.
   3. Examined Drawings and Specifications of all trades including Architectural, Structural and Electrical, and is proficient, experienced and knowledgeable of all standards, codes, ordinances, permits and regulations which affect his respective trade, and that all costs are included in his proposal.

B. The Mechanical Contractor and/or Sub-Contractor shall insure all required permits, and assessments have been obtained prior to any work beginning. Contractor shall verify requirement to include privilege fees, plan review fees, and permits as part of his formal bid.

C. Field Changes:
   1. This Mechanical Contractor shall not make any field changes that affect the system design, equipment manufacturer, timing, costs, or performance without written approval from the Mechanical and Plumbing Engineer. Approval shall be in the form of a written Field Change Request or Change Order, or supplemental memorandum addressed to the Engineer. All Change Orders shall be directed through the General Contractor and Architect.
   2. The Contractor assumes liability for any additional costs for changes requested. Should any unauthorized change be determined by the Engineer and Architect as lessening the value of the project, a credit will be request, and shall be issued as a change to the contract.

1.04 STANDARDS, CODES, AND PERMITS

A. Refer to Division 01, General Requirements and Supplementary Conditions.

B. All work shall comply with the latest edition of applicable standards and codes of following:
   1. ASA - American Standards Association
   2. ASME - American Society of Mechanical Engineers
   3. ASTM - American Society of Testing Materials
   4. ANSI - American National Standards Institute
   5. AGA - American Gas Association
   6. ASHRAE - American Society of Heating, Refrigerating, and Air Conditioning Engineers
   7. AWWA - American Water Works Association
   8. NFPA - National Fire Protection Association
   9. IBR - Institute of Boiler and Radiator Manufacturers
   10. AWS - American Welding Society
   11. UL - Underwriter's Laboratories
   12. NEMA - National Electric Manufacturers Association
   13. NEC - National Electric Code
   14. ARA - American Refrigeration Association
   15. OSHA - Occupational Safety and Health Act
   16. ABMA - American Boiler Manufacturers Association
   17. International Mechanical Code 2009
   18. International Plumbing Code 2009 (with Michigan Amendments)
   19. Michigan Mechanical Code 2009

C. All work shall be provided and tested in accordance with all applicable local county, state laws, ordinances, codes, rules and regulations.

D. No work shall be covered or enclosed by walls, ceilings, or other, until the work is tested in accordance with applicable codes and regulations, and successful tests witnessed and approved by authorized inspection authority. Written approvals shall be secured by the Mechanical Contractor and submitted to Engineer before final acceptance of work will be granted.

1.05 SUBMITTALS

A. Proposal Supplement:
   1. Contractor to submit ONE (1) copy of Proposal Supplement - SECTION 23 00 10 - MECHANICAL EQUIPMENT AND MATERIALS, at the time of Bid opening, listing the manufacturers upon which his bid was based, including all items being provided by Sub-Contractors.
   2. After Proposal Supplement and Sub-Contractors are approved, no deviation shall be permitted without written approval of Engineer.

B. Shop Drawings:
   1. Submit a minimum of EIGHT (8) copies of shop drawings on all equipment and materials indicated on the Drawings for approval, prior to placing delivery orders (also refer to Architectural Specifications for shop drawing requirements).
   2. At the time of submittal for review by the Engineer, shop drawings shall include signatures or stamps indicating that the Contractor and/or the Sub-Contractor has reviewed the submittals and has coordinated the required space, quantities required, services and work of other trades for the equipment or system being submitted.
   3. Submittals shall be in the form of bound folders with the name of the Project, Architect, Engineer and the submitting Contractor indicated on the cover. Submittals requiring drawings too large to be bound into the folder shall be folded and inserted in pockets bound into the folder.
   4. Provide shop drawings of all manufactured equipment and materials except pipe, pipe fittings and galvanized ductwork. Drawings shall include equipment capacities, weights, dimensions, construction details, installation, controls, wiring diagrams, and motor data.
   5. Engineer's approval of shop drawings is for general application only and is a service only and not considered as a guarantee of total compliance with or as relieving the Mechanical Contractor of basic responsibilities under all contract documents, and does not approve changes in time or cost.
   6. After approval, the Mechanical Contractor and its subcontractors are responsible to provide information to all other trades involved in, or affected by, the installation of the Mechanical and Plumbing equipment.

C. Record (As-Built) Drawings:
   1. At substantial completion of construction, furnish record (as-built) plans to the Engineer for approval. As part of the Final Punch List/Close-out, approved as-built plans shall be provided to the Owner.
   2. Record drawings shall include, at the minimum:
      a. The location and performance data on each piece of equipment.
      b. The general configuration of duct and pipe distribution systems, including sizes.
      c. The terminal air or water design flow rates.

D. Operating and Maintenance Manuals:
   1. The Mechanical Contractor and subcontractors shall provide TWO (2) bound and indexed (with tabs for each section) sets of operating and maintenance instructions to the Engineer for review as part of the Final Punch List/Close-out. The Engineer will provide approved manuals to the Owner.
   2. These manuals shall be in accordance with industry-accepted standards and shall include, at the minimum:
      a. Submittal data stating equipment size and selected options for each piece of equipment requiring maintenance.
      b. Operation and Maintenance manuals for each piece of equipment requiring maintenance. Required routine maintenance actions shall be clearly identified.
      c. Names and addresses of at least one (1) service agency.
      d. HVAC controls system maintenance and calibration information, including:
         1) Wiring diagrams
         2) Control schematics
         3) Control sequence of operation descriptions
      e. HVAC control drawings with desired or field-determined set points permanently recorded and indicated.

1.06 MECHANICAL UTILITY SERVICE REQUIREMENTS

A. Exterior plumbing services including sanitary drain and storm drain systems beyond 5 feet from the building are covered within the scope of the Civil Engineer on this project.

PART II PRODUCTS

2.01 STANDARDS

A. All products shall be furnished by established manufacturers regularly engaged in making the type of materials to be provided and complete with all parts, accessories, connections, etc. as specified or as recommended and/or required by the manufacturer.

B. All material where applicable shall be labeled or listed by Underwriters Laboratories, Inc.

C. All materials and equipment shall be installed in strict compliance with manufacturer's installation instructions. Where special installations or deviations are required, written approval from the manufacturer is required, and shall not void the manufacturer warranty.

2.02 SUBSTITUTIONS AND CHANGES

A. The Contractor and/or Equipment Supplier may propose alternate equipment or materials of EQUAL or better quality, function, performance, durability and appearance. This information is to be submitted to the Engineer's Office TEN (10) working days prior to bid due date to allow for proper review time and to issue an addendum incorporating the acceptable substitution(s). It is the submitter's responsibility to provide sufficient material for review as required by Engineer's Office. Acceptance and approval is the responsibility of the Engineer.

B. The Contractor and/or Equipment Supplier is liable for any added costs to himself or others and is responsible for verifying dimensions, clearance and roughing-in requirements, when product not named as the basis of design are used and is responsible for advising other Contractors of variations and submit revised drawing layout for approval of Engineer.

C. See SECTION 23 00 10 for voluntary alternates.
   1. No substitutions will be accepted after bids are received.
   2. When only one manufacturer is listed within the description of the mechanical equipment, the design engineering or project requirements will not allow substitution of other manufacturers.
   3. Contractor will be responsible for ALL costs (engineering time, manufacturer's costs, distributor costs, etc.) incurred to replace equipment not approved if substitutions are made by the distributor, manufacturer's rep., contractor or subcontractor.

D. Equipment not listed in the Mechanical Schedules or this Division 23, or not approved in writing by the Engineer, shall be separated from the Base Bid and shall be listed as a Voluntary Alternate only. Before acceptance, all Voluntary Alternates must be approved by the Engineer and Architect, and must be approved for use by any special Specifications related to the job.

E. The Mechanical Contractor is responsible and liable for any added costs to themselves or others that may be a result from use of Approved Alternates or Voluntary Alternates.

F. The Mechanical Contractor is responsible for bidding the Mechanical and Plumbing materials such as pipe and ductwork materials as listed on the Mechanical Drawings and this Division 23 Specification. Alternate materials or value engineering must be pre-approved by the Engineer, prior to bid submittal. Approval of alternate materials must be shared with the Architect, Owner, and other bidders.

2.03 ELECTRICAL REQUIREMENTS AND CONNECTIONS

A. General:
   1. When the Mechanical equipment not named as the basis of design is approved for use, the Mechanical Contractor is responsible for any costs incurred by other trades, including revisions to the Electrical requirements such as conduit, wire, starters, heaters, fused switches, disconnects, or circuit breakers.
   2. Electrical items furnished shall bear the Underwriter's Laboratories label and the installation shall comply with requirements of the National Electric Code, ANSI, IPCEA, IRI, and local codes, ordinances and regulations.

B. Motor Starters and Controls:
   1. The Electrical Contractor shall provide all manual or magnetic motor starters as required for all motors as indicated on all Electrical Drawings.

2. The Mechanical Contractor shall provide factory installed motor starters integral with packaged equipment containing thermal overcurrent protection in all underground conductors with heater coils selected for specific motor usage for all motors.

C. Electrical Wiring and Controls:
   1. The Mechanical Contractor shall furnish and install all motors, drives, controllers integral to equipment and factory mounted controls for all mechanical equipment.
   2. The Mechanical Contractor or Temperature Control Contractor shall furnish and install all electrical devices requiring mechanical connections, and/or electrical connections, such as thermostats, UL rated temperature control cabinets, etc., as listed in the Division 23 Contract Documents.
   3. The Temperature Control Contractor or Mechanical Contractor shall furnish and install all power and Class 2 and 3 wiring (low voltage), conduit, and electrical boxes associated with the Temperature Control System. Verify with Mechanical and Electrical Engineer whether plenum-rated, low voltage wiring is required.
   4. The Electrical Contractor shall install all Class 1 (120 volt and greater) power wiring, conduit to motors and/or factory mounted control panels as indicated on Electrical Drawings or as indicated in Specifications.
   5. All electrical wiring work by the Mechanical Contractor and Temperature Control Contractor shall be in accordance with Division 26 requirements.

PART III EXECUTION

3.01 COORDINATION OF MECHANCIAL WORK

A. Responsibility:
   1. The Mechanical Contractor shall be responsible for all Sub-Contractors and Suppliers, and include in his bid all materials, labor and equipment involved in accordance with all local regulations, jurisdictional awards, decisions, and secure compliance of all parts of the Specifications and Drawings regardless of sectional inclusion in these Specifications.
   2. The Mechanical Contractor and Sub-Contractors shall be responsible for all parts applicable to the job in accordance with the Specifications and Drawings, and shall be responsible for coordinating locations and arrangements of all Mechanical and Plumbing work with all other relevant Architectural, Structural, Electrical, and fire protection Mechanical Drawings, shop drawings, and Specifications.

B. Submission of a bid proposal is considered evidence that the Mechanical Contractor and its Sub-Contractors are fully capable of providing the following and have included the following in their bid proposal:
   1. Fully proficient and experienced to do the work described in the contract documents.
   2. Knowledgeable of all federal, state, and local standards, codes, ordinances, permits, and regulations that pertain to the work described in the contract documents.
   3. Have properly estimated the time and workforce, including subcontractors, needed to complete the job by the due date.
   4. Have included all material, equipment, and labor costs for completion of the job, including all subcontractors' costs.
   5. Have all the equipment, tools, supplies, vehicles, and trailers to complete the job.
   6. Have included all travel, food and lodging expenses.

C. Installation of Mechanical Systems:
   1. Install all Mechanical equipment as shown on the Mechanical Drawings. Deviations of the Mechanical systems and/or installation locations shall be approved by the Engineer.
   2. Changes or deviations of the Mechanical systems design and/or installation locations may require redrawing and resubmittal of the Mechanical Drawings to the state or local Mechanical or building inspector.
   3. Any costs associated with re-drawing and resubmittal of the Mechanical and Plumbing Drawings that did not have pre-approval from the Mechanical Engineer, may be charged to the Mechanical Contractor or Mechanical subcontractors. All costs shall be based on a time and materials basis.

4. Minor deviations from the original design will be accepted, but a written request or courtesy call to the Engineer is required. The Engineer may request a written report of the situation and a written request for record.

3.02 EQUIPMENT CLEARANCE

A. The Mechanical Contractor shall coordinate with the Electrical Contractor's equipment location to insure adequate clearance is maintained as required by the National Electrical Code and applicable state and local codes, as well as accessibility for future maintenance and operation.

B. Mechanical work shall be arranged with building construction to provide minimum 6'-8" overhead clearance where possible.

C. Install equipment in a neat and workmanlike manner. Install, align, and level all Mechanical equipment so that it may be easily accessed, adjusted, serviced, and balanced.

D. Install equipment so that filters, valves, and controls may be easily accessed.

E. Install equipment so that it does not block or limit access to other equipment, access panels, etc.

F. Install equipment so that it may be easily inspected.

3.03 GENERAL SUPPORTS

A. Mechanical Contractor shall provide all necessary channel, angle, brackets, vibration isolators, or supplementary steel as required for adequate support for all piping, specialties, ductwork, and equipment which is hung from the ceiling or roof, or mounted to the floor or roof. For equipment requiring welding or bolting to steel framing, or anchoring to concrete structures, the Mechanical Contractor shall require written approval from the Architect and General Contractor.

B. Where piping or equipment is suspended from concrete construction, coordinate with the General Contractor to set approved concrete inserts that shall receive hanger rods such as UniStrut in the concrete form-work. In metal decks, coordinate with General Contractor to use Ramset or welds as required.

3.04 WALL, FLOOR, CEILING, AND ROOF OPENINGS

A. Locate all openings and advise the General Contractor of details and templates of all openings necessary for inspection of Mechanical work.

B. All openings including saw cuts, cores, and required lintels shall be provided by the General Contractor, and shall be approved by the Architect and Structural Engineer. Size and location are the responsibility of the Mechanical Contractor. Cracks and rough edges left following installation of equipment shall be caulked, fire-caulked if required, or filled by the Mechanical Contractor.

C. Perform or pay for all cutting, fitting, repairing, patching and finishing of work of other sections where it is necessary to disturb such work to permit installation of mechanical work.

D. All roof openings including saw cuts and cores through the roof deck shall be provided by the General Contractor, and shall be approved by the Architect and Structural Engineer. Size and location of the openings are the responsibility of the Mechanical Contractor.

E. All roof curbs, Pate Curbs, or other specialty curbs shall be the responsibility of the Mechanical Contractor. Specialty roof curb flashings or curb-membranes shall be included.

F. All roofing materials including standard flashing, and the installation of roofing systems around the Mechanical equipment shall be the responsibility of the General Contractor.

G. All roof deck supporting materials including angles, joists, etc., shall be the responsibility of the General Contractor, and shall be approved by the Architect and Structural Engineer.

3.05 FIELD CHANGES

A. The Mechanical Contractor shall not make any field changes that affect the system design, equipment manufacturer, timing, costs, or performance without written approval from the Mechanical and Plumbing Engineer. Approval shall be in the form of a written Field Change

Request or Change Order, or Supplemental Instruction. All Change Orders shall be directed through the General Contractor and Architect.

B. The Contractor assumes liability for any additional costs for changes requested. Should any unauthorized change be determined by the Engineer and Architect as lessening the value of the project, a credit will be request, and shall be issued as a change to the contract.

3.06 PROJECT CLOSE-OUT

A. Final Acceptance and payment will only be made after final Punch-List completion and receipt at the Engineer's Office of:
   1. Approved Operating and Maintenance Instruction Manuals
   2. Approved Record Drawings (As Builts)
   3. All Guarantees/Warranties
   4. Certificates of Inspection
   5. Written and signed verification that Owner's Training has taken place
   6. Final Test and Balance Report (reference SECTION 23 05 93 for Report requirements)
   7. All extra materials specified to be provided within the Contract Documents

3.07 CERTIFICATES OF INSPECTION

A. Submit to the Engineer's Office evidence that installation has been inspected and approved by local or state mechanical inspector and/or the authority having jurisdiction.

3.08 GUARANTEES AND WARRANTIES

A. All labor, materials and equipment shall be guaranteed by Contractor and/or warranted by Manufacturer for ONE (1) year after acceptance date except where specified longer for special equipment. Contractor shall secure such warranty from all Suppliers (not one year from shipment date) or Contractor to assume warranty.

B. Acceptance date of substantial completion shall be Owner occupancy as determined by Architect/Engineer.

C. Contractor shall make all necessary alterations, repairs, adjustments, and replacements during guarantee periods as directed by Architect/Engineer to comply with Drawings and Specifications at no cost to Owner.

D. Repair or replacements made under guarantee bear further ONE (1) year guarantee from date of acceptance of repair or replacement.

E. At the end of a one year period of continuous operation, make a complete inspection of all systems, fixtures, equipment, safety devices and controls to insure equipment is operating properly, and report to Engineer in writing.

3.09 PLACING EQUIPMENT INTO OPERATION

A. Mechanical Contractor shall be responsible for all startup procedures, system checks and balancing associated with his equipment.

B. All equipment shall be installed, tested and operated in accordance with manufacturer's recommendations at normal operating conditions.

C. All permanent mechanical equipment operated during construction periods shall be cleaned and damaged equipment replaced.

3.10 OWNER'S TRAINING

A. The option of videotaping any and all training sessions shall be given to the Owner at no additional cost, with the Contractor conducting the videotaping and with TWO (2) copies of all tapes being turned over to the Owner for future use.

B. The Mechanical Contractor shall conduct TWO (2) - 2-hour training session(s) on the operation and maintenance of all mechanical equipment. Schedule training with Owner at least 72 hours prior to session(s).

END OF SECTION

SECTION 23 00 10
MECHANICAL EQUIPMENT AND MATERIALS

PART 1 GENERAL

1.01 INSTRUCTION:

A. The Mechanical Contractor is to either copy or remove this specification section from the Project Specification book and complete as follows:
   1. Indicate the specific manufacturer on which the bidder's base bid price is based in the blank space provided.
   2. All equipment is to be bid as specified. Material or equipment from another manufacturer may be bid as a Voluntary Alternate, but the dollar amount must be shown as an "Add" or "Deduct" to the base bid. Provide the name of the alternate manufacturer in the space provided.
   3. Insert the name(s) of each subcontractor used in your bid in the space provided in Part 3.
   4. This form shall be submitted with the bid.

1.02 RELATED DOCUMENTS:

A. The other Contract Documents complement the requirements of this Section. The General Requirements apply to the work of this section.

1.03 DEVIATIONS FROM SPECIFIED MATERIAL:

A. See SECTION 23 00 00, Part 2, Paragraph 2.02 - Substitutions and Changes. Base bid shall be based on manufacturers listed in this specification or on the drawings.

PART 2 PRODUCTS

2.01 THE FOLLOWING IS A LIST OF APPROVED MANUFACTURERS, GROUPED ACCORDING TO TYPES OF MATERIALS OR EQUIPMENT.

A. Make-Up Air Unit(s):
   1. Thermotek and Greenheck

C. Electric Heater(s):
   1. Berko and Redd-I

E. Exhaust/Supply Fan(s):
   1. Greenheck, Cook, Acme, Fantech, and PennBarry

PART 3 SUB-CONTRACTORS

3.01 INSERT THE NAME OF EACH SUB-CONTRACTOR AND WORK TO BE PERFORMED BELOW:

A. Subcontractor_____
   Work Performed_____

B. Subcontractor_____
   Work Performed_____

END OF SECTION

SECTION 23 05 53
MECHANICAL IDENTIFICATION FOR PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nameplates.

B. Tags.

C. Pipe Markers.

1.02 REFERENCE STANDARDS

A. ASME A13.1 - Scheme for the Identification of Piping Systems; The American Society of Mechanical Engineers; 2007.

B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2001 (Reapproved 2007).

PART 2 PRODUCTS

2.01 IDENTIFICATION APPLICATIONS

A. Air Handling Units: Nameplates.

B. Control Panels: Nameplates.

C. Piping: Pipe markers.

D. Small-sized Equipment: Nameplates.

E. Thermostats: Nameplates.

2.02 NAMEPLATES

A. Manufacturers:
   1. Advanced Graphic Engraving: www.advancedgraphicengraving.com.
   2. Kolbi Pipe Marker Co.: www.kolbipipemarkers.com.
   3. Seton Identification Products: www.seton.com.

B. Letter Color: White.

C. Letter Height: 1/2 inch (13 mm).

D. Background Color: Black.

E. Plastic: Conform to ASTM D709.

2.03 TAGS

A. Manufacturers:
   1. Advanced Graphic Engraving: www.advancedgraphicengraving.com.
   2. Brady Corporation: www.bradycorp.com.
   3. Kolbi Pipe Marker Co.: www.kolbipipemarkers.com.
   4. Seton Identification Products: www.seton.com.

B. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch (40 mm) diameter.

C. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch (40 mm) diameter with smooth edges.

D. Valve Tag Chart: Typewritten letter size list in anodized aluminum frame.

2.04 PIPE MARKERS

A. Manufacturers:
   1. Brady Corporation: www.bradycorp.com.
   2. Kolbi Pipe Marker Co.: www.kolbipipemarkers.com.
   3. MIFAB, Inc.: www.mifab.com.
   4. Seton Identification Products: www.seton.com.

B. Color: Conform to ASME A13.1.

C. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

D. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

E. Color code as follows:
   1. Heating, Cooling, and Boiler Feedwater: Green with white letters.
   2. Toxic and Corrosive Fluids: Orange with black letters.
   3. Compressed Air: Blue with white letters.

2.05 CEILING TACKS

A. Manufacturers:
   1. Craftmark: www.craftmarkid.com.

B. Description: Steel with 3/4 inch (20 mm) diameter color coded head.

C. Color code as follows:
   1. HVAC Equipment: Yellow.
   2. Fire Dampers and Smoke Dampers: Red.
   3. Heating/Cooling Valves: Blue.

PART 3 EXECUTION

3.01 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.02 INSTALLATION

A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

B. Install tags with corrosion resistant chain.

C. Install plastic pipe markers in accordance with manufacturer's instructions.

D. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.

E. Use tags on piping 3/4 inch (20 mm) diameter and smaller.
   1. Identify service, flow direction, and pressure.
   2. Install in clear view and align with axis of piping.
   3. Locate identification not to exceed 20 feet (6 m) on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.

F. Locate ceiling tacks to locate valves or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION

SECTION 23 05 93
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Testing, adjustment, and balancing of air systems.

B. Measurement of final operating condition of HVAC systems.

1.02 REFERENCE STANDARDS

A. AABC MN-1 - AABC National Standards for Total System Balance; Associated Air Balance Council; 2002.

B. ASHRAE Std 111 - Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.; 2008.

C. NEBB (TAB) - Procedural Standards for Testing Adjusting Balancing of Environmental Systems; National Environmental Balancing Bureau; 2005, Seventh Edition.

D. SMACNA (TAB) - HVAC Systems Testing, Adjusting, and Balancing; Sheet Metal and Air Conditioning Contractors' National Association; 2002.

1.03 SUBMITTALS

A. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
   1. Revise TAB plan to reflect actual procedures and submit as part of final report.
   2. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Engineer and for inclusion in operating and maintenance manuals.
   3. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
   4. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
   5. Units of Measure: Report data in I-P (inch-pound) units only.
   6. Include the following on the title page of each report:
      a. Name of Testing, Adjusting, and Balancing Agency.
      b. Address of Testing, Adjusting, and Balancing Agency.
      c. Telephone number of Testing, Adjusting, and Balancing Agency.
      d. Project name.
      e. Project location.
      f. Project Engineer.
      g. Project Contractor.
      h. Report date.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. Perform total system balance in accordance with one of the following:
   1. AABC MN-1, AABC National Standards for Total System Balance.
   2. NEBB Procedural Standards for Testing Adjusting Balancing of Environmental Systems.
   3. SMACNA HVAC Systems Testing, Adjusting, and Balancing.
   4. NBC, National Balancing Council.

B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.

C. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.

D. TAB Agency Qualifications:
   1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.
   2. Having minimum of three years documented experience.
   3. Certified by one of the following:
      a. AABC, Associated Air Balance Council: www.aabchq.com; upon completion submit AABC National Performance Guaranty.
      b. TABB, The Testing, Adjusting, and Balancing Bureau of National Energy Management Institute: www.tabbcertified.org.
      c. NBC, National Balancing Council: www.nbctab.org.

E. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

3.02 EXAMINATION

A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
   1. Systems are started and operating in a safe and normal condition.
   2. Temperature control systems are installed complete and operable.
   3. Proper thermal overload protection is in place for electrical equipment.
   4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
   5. Duct systems are clean of debris.
   6. Fans are rotating correctly.
   7. Fire and volume dampers are in place and open.
   8. Access doors are closed and duct end caps are in place.
   9. Air outlets are installed and connected.
   10. Duct system leakage is minimized.

B. Beginning of work means acceptance of existing conditions.

3.03 ADJUSTMENT TOLERANCES

A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.

B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

3.04 RECORDING AND ADJUSTING

A. Ensure recorded data represents actual measured or observed conditions.

B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

C. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

D. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

3.05 SCOPE

A. Test, adjust, and balance the following:
   1. Make-up Air Units
   2. Fans
   3. Air Inlets and Outlets

END OF SECTION

SECTION 23 07 13
DUCT INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Duct Liner.

1.02 REFERENCE STANDARDS

A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2010.

B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]; 2010.

C. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2010.

D. ASTM C553 - Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2011.

E. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2010.

F. ASTM C916 - Standard Specification for Adhesives for Duct Thermal Insulation; 1985 (Reapproved 2007).

G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2013a.

H. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2012.

I. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; National Fire Protection Association; 2006.

J. SMACNA (DCS) - HVAC Duct Construction Standards; Sheet Metal and Air Conditioning Contractors' National Association; 2005.

K. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

1.03 SUBMITTALS

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section with not less than three years of experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.

B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.06 FIELD CONDITIONS

A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.01 REQUIREMENTS FOR ALL PRODUCTS OF THIS SECTION

A. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84, NFPA 255, or UL 723.

2.02 GLASS FIBER, FLEXIBLE

A. Manufacturer:
   1. Knauf Insulation: www.knaufusa.com.
   2. Johns Manville Corporation: www.jm.com.
   3. Owens Corning Corp: www.owenscorning.com.
   4. CertainTeed Corporation: www.certainteed.com.

B. Insulation: ASTM C553; flexible, noncombustible blanket.
   1. 'K' ('Ksi') value: 0.31 at 75 degrees F (0.045 at 24 degrees C), when tested in accordance with ASTM C518.

C. Vapor Barrier Jacket:
   1. Kraft paper with glass fiber yarn and bonded to aluminized film.
   2. Secure with pressure sensitive tape.

2.03 DUCT LINER

A. Insulation: Incombustible glass fiber complying with ASTM C1071; flexible blanket; impregnated surface and edges coated with acrylic polymer shown to be fungus and bacteria resistant by testing to ASTM G 21.
   1. Apparent Thermal Conductivity: Maximum of 0.31 at 75 degrees F (0.045 at 24 degrees C).

B. Adhesive: Waterproof, fire-retardant type, ASTM C916.

C. Liner Fasteners: Galvanized steel, self-adhesive pad with integral head.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that ducts have been tested before applying insulation materials.

B. Verify that surfaces are clean, foreign material removed, and dry.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards.

C. Exterior Applications: Provide insulation with vapor barrier jacket. Cover with with calked aluminum jacket with seams located on bottom side of horizontal duct section.

D. Duct and Plenum Liner Application:
   1. Adhere insulation with adhesive for 90 percent coverage.
   2. Secure insulation with mechanical liner fasteners. Refer to SMACNA HVAC Duct Construction Standards for spacing.
   3. Duct dimensions indicated are net inside dimensions required for air flow. Increase duct size to allow for insulation thickness.

3.03 SCHEDULES

A. Supply Air Ducts Exposed to Outdoors:
   1. Flexible Glass Fiber Duct Liner Insulation: installed thickness to provide R-value of R-8.
   2. Duct dimensions on drawing are INTERIOR dimensions.
   3. Seal duct seams with 100% silicone caulk or duct sealant rated for exterior use.

END OF SECTION

SECTION 23 09 13
INSTRUMENTATION AND CONTROL DEVICES FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Thermostats.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

A. AMCA 500-D - Laboratory Methods of Testing Dampers for Rating 2018.

B. NEMA DC 3 - Residential Controls - Electrical Wall-Mounted Room Thermostats 2013.

C. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems 2018.

1.04 SUBMITTALS

A. Product Data: Provide description and engineering data for each control system component. Include sizing as requested. Provide data for each system component and software module.

B. Project Record Documents: Record actual locations of control components, including panels, thermostats, and sensors. Accurately record actual location of control components, including panels, thermostats, and sensors.
   1. Revise shop drawings to reflect actual installation and operating sequences.

C. Operation and Maintenance Data: Include inspection period, cleaning methods, recommended cleaning materials, and calibration tolerances.

PART 2 PRODUCTS

2.01 EQUIPMENT - GENERAL

A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

2.02 DAMPERS

A. Performance: Test in accordance with AMCA 500-D.

B. Frames: Galvanized steel, welded or riveted with corner reinforcement, minimum 16 gage, 16 inch (1.5 mm).

C. Blades: Galvanized steel, maximum blade size 8 inches (200 mm) wide, 48 inches (1200 mm) long, minimum 16 gage, 16 inch (1.5 mm), positively locked to square shafts 1/2 inch (13 mm).

D. Blade Seals: Synthetic elastomeric mechanically attached, field replaceable.

E. Jamb Seals: Spring stainless steel.

F. Shaft Bearings: Corrosion resistant, permanently lubricated synthetic sleeve.

2.03 DAMPER OPERATORS

A. General: Provide smooth proportional control with sufficient power for air velocities 20 percent greater than maximum design velocity and to provide tight seal against maximum system pressures. Provide spring return for two position control and for fail safe operation.
   1. Provide sufficient number of operators to achieve unrestricted movement throughout damper range.

2.04 THERMOSTATS

A. Electric Room Thermostats:
   1. Type: NEMA DC 3, 24 volts, with setback/setup temperature control.
   2. Service: cooling and heating.

B. Line Voltage Thermostats:
   1. Integral manual On/Off/Auto selector switch, single or two pole as required.

2. Dead band: Maximum 2 degrees F (one degree C).
3. Rating: Motor load.

C. Room Thermostat Accessories:
1. Insulating Bases: For thermostats located on exterior walls.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Check and verify location of thermostats with plans and room details before installation. Locate 60 inches (1500 mm) above floor. Align with lighting switches and humidistats. Refer to Section 26 27 26.

C. Provide conduit and electrical wiring in accordance with Section 26 05 83. Electrical material and installation shall be in accordance with appropriate requirements of Division 26.

END OF SECTION

SECTION 23 09 93
SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This section defines the manner and method by which controls function. Requirements for each type of control system operation are specified. Equipment, devices, and system components required for control systems are specified in other sections.

B. Sequence of operation for:
   1. Electric Unit Heater (EH-1).
   2. Headworks Screenings & Grit: Make-up Air Unit (MAU-1) and Exhaust Fan (EF-1).
   3. Electric Unit Heater (EH-2)

1.02 SUBMITTALS

A. Sequence of Operation Documentation: Submit written sequence of operation for entire HVAC system and each piece of equipment.
   1. State each sequence in small segments and give each segment a unique number for referencing in Functional Test procedures; provide a complete description regardless of the completeness and clarity of the sequences specified in the contract documents.
   2. Include at least the following sequences:
      a. Normal operating mode.
      b. Unoccupied mode.
      c. Shutdown.
      d. Detailed sequences for all control strategies, such as economizer control, optimum start/stop, staging, optimization, demand limiting, etc.
      e. Interactions and interlocks with other systems.
   3. Include initial and recommended values for all adjustable settings, setpoints and parameters that are typically set or adjusted by operating staff; and any other control settings or fixed values, delays, etc. that will be useful during testing and operating the equipment.
   4. For packaged controlled equipment, include manufacturer's furnished sequence of operation amplified as required to describe the relationship between the packaged controls and the control system, indicating which points are adjustable control points and which points are only monitored.

B. Project Record Documents: Record actual locations of components and setpoints of controls, including changes to sequences made after submission of shop drawings.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 ELECTRIC UNIT HEATERS (EH-1)

A. Single temperature room thermostat set at 68 degrees F (20 degrees C) maintains constant space temperature by cycling unit fan motor and electric heating elements.

3.02 HEADWORKS SCREENINGS: MAKE-UP AIR UNIT (MAU-1) & EXHAUST FAN (EF-1)

A. ALL CONTROLS, WIRING AND CONTROL ENCLOSURES SHALL BE RATED EXPLOSION PROOF (CLASS 1, DIVISION 2, GROUP D, NEMA 7) IN THIS AREA.

B. Both MAU-1 and EF-1 fans shall operate continuously.

C. Outside Air Damper: When supply fan is running, open outside air damper.

D. MAU-1 remote panel shall modulate the unit gas burner to maintain constant discharge air temperature setpoint. Panel shall be mounted in Equipment Room.

E. Equip unit with supply air isolation damper with actuator end switch. Interlock unit supply fan with damper end switch (damper must be open prior to fan starting).

F. When unit starts, a purge cycle of a minimum of 7 seconds shall begin prior to energizing unit heat.

3.03 ELECTRICAL ROOM EXHAUST FANS (EF-2)

A. On room temperatures above 90 degrees F (32 degrees C) open intake damper and start exhaust fan.

END OF SECTION

SECTION 23 31 00
HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal ductwork.

1.02 RELATED REQUIREMENTS

A. Section 23 07 13 - Duct Insulation: External insulation and duct liner.

B. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC.

1.03 REFERENCE STANDARDS

A. ASHRAE (FUND) - ASHRAE Handbook - Fundamentals; 2009.

B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2012.

C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2011.

D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2013a.

E. SMACNA (LEAK) - HVAC Air Duct Leakage Test Manual; Sheet Metal and Air Conditioning Contractors' National Association; 2012, 2nd Edition.

F. SMACNA (DCS) - HVAC Duct Construction Standards; 2005.

1.04 FIELD CONDITIONS

A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.

B. Maintain temperatures within acceptable range during and after installation of duct sealants.

PART 2 PRODUCTS

2.01 DUCT ASSEMBLIES

2.02 MATERIALS

A. Galvanized Steel for Ducts: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G90/Z275 coating.

B. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
   1. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure class of ducts.
   2. Surface Burning Characteristics: Flame spread of zero, smoke developed of zero, when tested in accordance with ASTM E84.
   3. Products:
      a. Carlisle HVAC Products; Hardcast Versa-Grip 181 Water Based Fiber Reinforced Duct Sealant: www.carlislehvac.com.

C. Hanger Rod: ASTM A36/A36M; steel; threaded both ends, threaded one end, or continuously threaded.

D. Low Pressure Supply (Heating Systems): 1 inch w.g. (250 Pa) pressure class, galvanized steel.

2.03 DUCTWORK FABRICATION

A. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards and as indicated.

B. No variation of duct configuration or size permitted except by written permission. Size round duct installed in place of rectangular ducts in accordance with ASHRAE Handbook - Fundamentals.

C. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

D. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows must be used, provide air foil turning vanes of perforated metal with glass fiber insulation.

E. Provide turning vanes of perforated metal with glass fiber insulation when acoustical lining is indicated.

F. T's, bends, and elbows: Construct according to SMACNA (DCS).

G. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

H. Fabricate continuously welded round and oval duct fittings in accordance with SMACNA HVAC Duct Construction Standards.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install, support, and seal ducts in accordance with SMACNA HVAC Duct Construction Standards.

B. Install in accordance with manufacturer's instructions.

C. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

D. Flexible Ducts: Connect to metal ducts with adhesive plus sheet metal screws.

E. Duct sizes indicated are inside clear dimensions. For lined ducts, maintain sizes inside lining.

F. Install and seal metal and flexible ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

G. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

H. Connect diffusers or light troffer boots to low pressure ducts with 6 foot maximum length of flexible duct held in place with strap or clamp.

I. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

J. At exterior wall louvers, seal duct to louver frame. Outdoor air ductwork shall be sloped to wall louver.

END OF SECTION

SECTION 23 34 23
HVAC POWER VENTILATORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wall exhausters.

1.02 REFERENCE STANDARDS

A. AMCA 99 - Standards Handbook; Air Movement and Control Association International, Inc.; 2010.

B. AMCA 204 - Balance Quality and Vibration Levels for Fans; 2005.

C. AMCA 210 - Laboratory Methods of Testing Fans for Aerodynamic Performance Rating; Air Movement and Control Association International, Inc.; 2007 (ANSI/AMCA 210, same as ANSI/ASHRAE 51).

D. AMCA (DIR) - [Directory of] Products Licensed Under AMCA International Certified Ratings Program; Air Movement and Control Association International, Inc.; http://www.amca.org/certified/search/company.aspx.

E. AMCA 300 - Reverberant Room Method for Sound Testing of Fans; Air Movement and Control Association International, Inc.; 2008.

F. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data; Air Movement and Control Association International, Inc.; 2007.

1.03 SUBMITTALS

B. Product Data: Provide data on fans and accessories including fan curves with specified operating point clearly plotted, power, RPM, sound power levels at rated capacity, and electrical characteristics and connection requirements.

1.04 EXTRA MATERIALS

B. Supply two sets of belts for each fan, where applicable.

PART 2 PRODUCTS

2.01 POWER VENTILATORS - GENERAL

A. Static and Dynamically Balanced: AMCA 204 - Balance Quality and Vibration Levels for Fans.

B. Performance Ratings: Determined in accordance with AMCA 210 and bearing the AMCA Certified Rating Seal.

C. Sound Ratings: AMCA 301, tested to AMCA 300, and bearing AMCA Certified Sound Rating Seal.

D. Fabrication: Conform to AMCA 99.

E. Electrical Components: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

F. Manufacturers:

1. Greenheck.
2. Fantech.
3. Loren Cook.
4. Acme.
5. PennBarry.

2.02 WALL EXHAUSTERS

A. Fan Unit: V-belt or direct driven with spun aluminum housing; resiliently mounted motor; 1/2 inch (13 mm) mesh, 0.062 inch (1.6 mm) thick aluminum wire bird screen.

B. Disconnect Switch: Factory wired, non-fusible, in housing for thermal overload protected motor, and wall mounted solid state speed controller. Shall be Class 1, Division 2 where indicated on plans.

C. Sheaves: For V-belt drives, provide cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

END OF SECTION

SECTION 23 74 33
ELECTRIC HEATING MAKE-UP AIR UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electric make-up air heater.

B. Controls.

1.02 REFERENCE STANDARDS

A. AHRI 210/240 - Standard for Performance Rating of Unitary Air Conditioning and Air-Source Heat Pump Equipment; Air-Conditioning, Heating, and Refrigeration Institute; 2008.

B. ASHRAE Std 23.1 - Methods of Testing for Rating Positive Displacement Refrigerant Compressors and Condensing Units; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.; 2010.

C. ASHRAE Std 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.; 2010, Including All Addenda (ANSI/ASHRAE/IESNA Std 90).

D. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; National Fire Protection Association; 2012.

E. UL 207 - Refrigerant-Containing Components and Accessories, Nonelectrical; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

1.03 SUBMITTALS

A. See Administrative Requirements, for submittal procedures.

B. Product Data: Provide data with dimensions, duct and service connections, accessories, controls, electrical nameplate data, and wiring diagrams.

C. Shop Drawings: Indicate dimensions, duct and service connections, accessories, controls, electrical nameplate data, and wiring diagrams.

D. Project Record Documents: Record actual locations of components.

E. Operation & Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

A. Unit Cabinet

1. Unit housing shall be constructed of 20 Gauge G-90 galvanized steel. The wall panels and roof panels shall be fabricated by forming double-standing, self-locking seams that require no additional support. The floor and wall panels shall be caulked air tight with a silicone caulk. All casing panels shall be attached with sheet-metal screws or rivets, which can be removed to service large components in the field. The unit base shall be suitable for curb or flat mount. Housing construction should be suitable for outdoor or indoor installation.

2. An observation port shall be located on the exterior of the unit for observing the coil. All controls and electrical components shall be mounted within the control vestibule. The vestibule shall be an integral part of the unit, not extend outside the exterior casing of the unit, and not be exposed to the main air stream.

3. The vestibule full-size door shall provide easy access to the controls. The blower door shall provide easy access to the blower, motor, and drives. Access doors shall be provided on both ends of the unit providing full access to every part of the unit.

B. Inlet Hood
   1. Provide unit with inlet hood of fabricated metal with birdscreen (include removable birdscreen rack).

C. Filter Section
   1. Filters of 2 inch thick Aluminum washable media with an integral frame are positioned in a V-bank arrangement of welded channels.
   2. Filter shall be UL Class 2 rated with a differential pressure switch installed to sense clogged filters and provide an alarm.

E. SCR Electric Coil
   1. Electric coils are controlled using SCR controls. SCR is a time proportioning type controller that modulates the heater and supplies the exact amount of power to match the heat demand.

   The SCR electric coil shall be sized to provide an output of 20 KW.

   Rear access doors or a removable lid will provide complete access to the SCR electric coil.

2.02 CONTROLS

A. Controls: Pre-wire unit for connection of power supply. Field wiring from unit to remote control panel makes unit operative.

B. Remote Control Panel: On-off -auto switch, indicating lights for supply fan, exhaust fan, pilot operation, burner operation, lockout indication, and clogged filter indication.

C. Fan Discharge Thermostat: Controls modulating gas valve to maintain supply air temperature.

D. All controls located within Screenings room are required to be NEMA 7, Class 1 Division 2 products. Screening room is Group D explosion proof area.

E. Safety:
   1. Motor starter with adjustable overloads
   2. Air-flow safety switch
   3. Blower interlock relay
   4. High-temperature limit switch
   5. Non-Fused Disconnect
   6. Casing insulation shall be 1" x 1.5# density with a foil face

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install to NFPA 90A.

C. Provide flexible duct connections on outlet from unit.

D. Install unit on concrete housekeeping pad and on a minimum 14” tall equipment stand.

3.02 MAINTENANCE

A. Provide service and maintenance of units for one year from Date of Substantial Completion.

END OF SECTION

SECTION 26 00 00
ELECTRICAL GENERAL PROVISIONS

PART 1 GENERAL

1.01 DESCRIPTION OF WORK:

A. Work included in this Division consists of providing all demolition, labor, materials, equipment, tools, supervision, start-up services, Owner's instructions, including all incidental and related items necessary to complete installation, and successfully test, start up and operate building in a practical and efficient manner. Electrical Systems indicated on Drawings and described in each Section of Division 26 Specification and conforming with all Contract Documents.

B. Work not included under this Division:
   1. Field painting of equipment, except for repair to damaged factory finishes.

C. The General Provisions of this Contract, including General and Supplementary Conditions and other General Requirements Sections, apply to the Work specified in this Section.

D. This Section is not intended to supersede, but to clarify, the definitions in Division 1, General Requirements and Supplementary Conditions.

1.02 DRAWINGS AND SPECIFICATIONS:

A. Drawings are diagrammatic and indicate general arrangement of systems and work included in Contract, and shall serve only as design drawings, and not as working drawings, for general layout of various equipment and systems.

B. Drawings and Specifications are intended to supplement each other, and all work specified or indicated in either shall be provided. Should drawings disagree in themselves or with Specifications, the better quality or greater quantity of work shall be provided.

C. Drawings and Specifications are intended to include all work and materials necessary for completion of the work. Any incidental item of material, labor or detail required for the proper execution and completion of the work and omitted from either the drawings and specifications or both, but required by governing codes local regulations, trade practices, operational functions, and good workmanship, shall be provided as part of the Contract Work without extra charge, even though not specifically detailed or specified.

1.03 SITE AND PROJECT DOCUMENT EXAMINATION:

A. Submission of a proposal is considered evidence the Contractor has visited site, examined Drawings and Specifications of all trades including Architectural, Structural and Mechanical, and fully informed himself with all project and site conditions, and is proficient, experienced and knowledgeable of all standards, codes, ordinances, permits and regulations which affect his respective trade, and that all costs are included in his proposal.

B. The Contractor and/or Sub-Contractor shall insure all required permits, and assessments have been obtained prior to any work beginning. Contractor shall verify requirement to include privilege fees, plan review fees, and permits as part of his formal bid.

1.04 STANDARDS, CODES AND PERMITS:

A. Refer to Division 1, General Requirements and Supplementary Conditions.

B. All work under Electrical Sections shall comply with latest edition of applicable standards and codes of the following, including local codes and variances:
   1. NECA - Standards for Installation
   2. NFPA - National Fire Protection Association
   3. NEC - Latest edition of NFPA 70
   4. UL - Underwriter's Laboratories
   5. NEMA - National Electric Manufacturers Association
   6. NESC - National Electric Safety Code (H13)
   7. OSHA - Occupational Safety and Health Act
   8. IEEE - Institute of Electrical and Electronics Engineers

C. All work shall be provided and tested in accordance with all applicable local, county, state laws, ordinances, code rules and regulations, including Michigan Department of Labor, General Rules, Part 8-Electrical Code Rules.

D. No work shall be covered or enclosed until work is tested in accordance with applicable codes and regulations, and successful tests witnessed and approved by authorized inspection authority. Written approvals shall be secured by Contractor and submitted to Engineer before final acceptance of work.

1.05 SUBMITTALS:

A. Proposal Supplement:
1. Contractor to submit one (1) copy of Proposal Supplement - SECTION 26 00 10 - ELECTRICAL EQUIPMENT AND MATERIALS, at the time of Bid opening, listing the manufacturers upon which his bid was based, including all items being provided by Sub-Contractors.
2. After Proposal Supplement and Sub-Contractors are approved, no deviation shall be permitted without written approval of Engineer.

B. Shop Drawings:
1. Submit nine (9) copies of shop drawings on all equipment and materials indicated in the specifications or on drawings.
2. At the time of submittal for review by the Engineer, shop drawings shall include signatures or stamps indicating that the Contractor and/or the Sub-Contractor has reviewed the submittals and has coordinated the required space, quantities required, services and work of other trades for the equipment or system being submitted.
3. Submittals shall be in the form of bound folders with the name of the Project, Architect, Engineer and the submitting Contractor indicated on the cover. Submittals requiring drawings too large to be bound into the folder shall be folded and inserted in pockets bound into the folder.
4. Submit complete manufacturer's shop drawings of all equipment, accessories, and controls, including dimensions, weights, capacities, construction details, installation, controls, wiring diagrams, and motor data.
5. Engineer's approval of show drawings is for general application only and is a service only and not considered as a guarantee of total compliance with or as relieving Contractor of basic responsibilities under all Contract Documents, and does not approve changes in quantities, time, or cost.
6. After approval, each Contractor is responsible to provide information to all other trades involved in, or affected by, installation of his equipment and work.

C. Operating and Maintenance Instructions and Manuals:
1. Contractor shall provide for all items of equipment three (3) bound and indexed sets of operating/installation and maintenance instructions to Engineer for approval. After approval, manuals will be given to Owner by the Engineer.
2. Manuals shall include a complete set of shop drawings submitted, indexed with tabs for each section.

1.06 ELECTRICAL SERVICE REQUIREMENTS:

A. Permanent Electrical Service:
1. The Contractor is to verify with the Electrical Utility Company the electrical system amperage, voltage and phase and report any variations from what is indicated on the drawings to the Engineer. Contractor is to obtain written verification of the available symmetrical and asymmetrical RMS fault current from the Electrical Utility Company. Basis of design and bidding shall be a minimum of 65,000 system integrated A.I.C. on "MDP-1" overcurrent devices and branch circuit panelboard overcurrent devices.
2. The Contractor shall select the over current protection devices and coordinate with the fault current. Submit a list of the devices and how coordination will be achieved. This submittal shall be in the form of a shop drawing.

3. Under the base bid, the Contractor shall furnish and install electrical conduits and conductors from main disconnect switch to pad mount transformer secondary terminals. Actual connection of wires to secondary terminals of transformer shall be done by the Electrical Utility Company.
4. The Contractor shall also supply and install the concrete pad for the new pad-mount transformer. Coordinate the size and requirements with the Electrical Utility Company.
5. Any costs from the Electrical Utility Company associated with bringing permanent power to the site shall be paid for by the Owner.
6. The Electrical Utility Company is Consumers Energy. Contact information for Amanda Hall at Consumers Energy is 231.929.6244.

PART 2 PRODUCTS

2.01 STANDARDS:

A. All products shall be of established manufacturers regularly engaged in making type of materials to be provided and complete with all parts, accessories, trimmings, connections, etc. as specified in detail or as described in manufacturer's catalog.

B. All material shall be labeled or listed by Underwriter's Laboratories, Inc. Assembled electrical equipment supplied to the job site shall be listed or labeled and/or approved by the authority having jurisdiction.

2.02 SUBSTITUTION AND CHANGES:

A. Contractor and/or Equipment Supplier may propose alternate equipment or materials of EQUAL or better quality, function, performance, durability, and appearance. This information is to be submitted to the Engineer's Office ten (10) working days prior to bid due date to allow for proper review time and to issue an addendum incorporating the acceptable substitution(s). It is the submitter's responsibility to provide sufficient material for review as required by Engineer's Office. Acceptance and approval are the responsibility of the Engineer.

B. Contractor and/or Equipment Supplier is liable for any added costs to himself or others and is responsible for verifying dimensions, clearance, and roughing-in requirements, when product not named as the basis of design are used and is responsible for advising other Contractors of variations and submit revised drawing layout for approval of Engineer.

C. See Section 26 00 10 for voluntary alternates.
1. No substitutions will be accepted after bids are received. The lighting or electrical equipment specified herein has been carefully chosen for its ability to meet the luminous performance and/or design criteria of this project. Substitutions in all likelihood will be unable to meet all of the same requirements as the specified equipment.
2. When only one manufacturer is listed within the description of the luminaire or electrical equipment, the design engineering or architectural aesthetics will not allow substitution of other manufacturer.
3. When two or more manufacturers are listed within the description of the luminaire or electrical equipment, the Contractor may elect to submit to the Engineer a substitute fixture for review. All submittals must follow paragraph 2.02.A of this section.
4. Substitution submittals shall consist of a physical description, dimensioned drawing and complete photometric and electric data of the proposed lamp, luminaire, or electrical equipment. Working samples may be requested and shall be supplied to the Engineer for a visual check of finish and operating characteristics.
5. Contractor will be responsible for ALL costs (engineering time, manufacturer's costs, distributor costs, etc.) incurred to replace equipment not approved if substitutions are made by the distributor, manufacturer's rep., contractor, or subcontractor.

2.03 EQUIPMENT REQUIREMENTS AND CONNECTIONS:

A. Motor Starters and Controls:
1. Contractor shall provide all manual or magnetic motor starters and combination motor starter disconnects as required for all motors as indicated on all Electrical Drawings.

2. Contractor shall provide factory installed motor starters integral with packaged equipment containing thermal overcurrent protection in all underground conductors with heater coils selected for specific motor usage for all motors.

B. Electrical Wiring and Controls:
1. Contractor shall furnish and install all motors, drives, and controllers integral to equipment and factory-mounted controls for all mechanical equipment.
2. Contractor shall furnish and install all electrical devices requiring mechanical connections, and/or electrical connections, such as pressure switches, limit switches, float switches, solenoid valves, motor operated valves, motor operated dampers, fire stats, freeze stats, thermostats, override timers, E.P.'s, P.E.'s, temperature control cabinet, air compressor with starter, etc.
3. Contractor shall furnish and install all power and Class 2 and 3 wiring, conduit, boxes for their association equipment in 2.03, B, 2.
4. Contractor shall install all power wiring, conduit to motors and/or factory mounted control panels as indicated on Electrical Drawings or as indicated in Specifications.
5. All electrical wiring work by Contractor shall be in accordance with Division 26 requirements.

C. Instrumentation Wiring and Controls:
1. Contractor shall furnish and install all conduits and cables as shown on plans. Contractor shall terminate all cables of Class 2 or 3.
2. Contractor shall furnish and install all electrical devices requiring electrical connections of 120v or higher voltage circuits. Contractor shall commission and calibrate all equipment.
3. All electrical wiring work shall be in accordance with Division 16 requirements.

PART 3 EXECUTION

3.01 COORDINATION OF ELECTRICAL WORK:

A. The Contractor shall be responsible for all Sub-Contractors and Suppliers, and include in his bid all materials, labor and equipment involved in accordance with all local customs, rules, regulations, jurisdictional awards, decisions and secure compliance of all parts of the Specifications and Drawings regardless of Sectional inclusion in these Specifications.

B. The Contractor and Sub-Contractor shall be responsible for all parts applicable to his trade in accordance with the Specifications and Drawings, and shall be responsible for coordinating locations and arrangements of his work with all other relevant Mechanical, Architectural, Structural and Electrical Specifications, Drawings and Shop Drawings.

3.02 EQUIPMENT CLEARANCE:

A. Contractor to coordinate with the equipment location to ensure adequate clearance is maintained as required by the National Electrical Code and applicable state and local codes, as well as accessibility for future maintenance and operation.

B. Electrical work shall be arranged with building construction to provide minimum 6'-8" overhead clearance where possible.

3.03 WALL, FLOOR AND CEILING OPENINGS:

A. Locate all openings and advise of details and templates of all openings necessary for inspection of electrical work.

B. In general, openings and required lintels shall be provided through this Contractor. Size and location are the responsibility of this Contractor. Cracks and rough edges left following installation of equipment shall be caulked or covered by Contractor.

3.04 FIELD CHANGES:

A. The Contractor shall not make any field changes that affect timing, costs, or performance without written approval from the Architect/Engineer in the form of a Change Order, Field Change Order or a Supplemental Instruction. The Contractor assumes liability for any additional costs for changes made without such instruction or approval. Should any

unauthorized change be determined by the Architect/Engineer as lessening the value of the project, a credit will be determined and issued as a change to the Contract.

3.05 PROJECT CLOSEOUT:

A. Final Acceptance and payment will only be made after final punch list completion and receipt at the Engineer's Office of:
   1. All Guarantees/Warranties
   2. Operating and Maintenance Instruction Manuals
   3. Record Drawings (As Builts)
   4. Certificates of Inspection
   5. Test Reports
   6. Lamps and ballasts.

3.06 CERTIFICATES OF INSPECTION AND TEST REPORTS:

A. Submit to the Engineer's Office evidence that installation has been inspected and approved by local or state electrical inspector and/or the authority having jurisdiction.

3.07 GUARANTEES AND WARRANTIES:

A. At the end of a one year period of continuous operation, make a complete inspection of all systems, fixtures, equipment, safety devices and controls to insure equipment is operating properly, and report to Engineer in writing.

3.08 RECORD DRAWINGS:

A. Maintain a white-print set of Electrical Contract Drawings in clean, undamaged condition for markup of actual installation on Electrical Contract Drawings which vary substantially from the work as shown. These drawings are to be available for inspection by the Engineer on a weekly basis. Drawings shall indicate at a minimum the routing of all conduits over 2" on size, revised circuiting, revised panel schedules, emergency lighting controller (EPCs, BLTCs, etc.) locations, and addendum, bulletin, and field changes.

3.09 OPERATING AND MAINTENANCE INSTRUCTIONS:

A. Provide instruction of Owner's personnel in operation and maintenance procedures for all systems equipment.

B. Provide 3 - bound & tabbed sets of operating & maintenance instruction manuals for all electrical equipment.

3.10 PLACING SYSTEMS INTO OPERATION:

A. Contractor shall be responsible for all startup procedures, system checks and balancing associated with his equipment.

B. All equipment shall be installed, tested, and operated in accordance with manufacturer's recommendations at normal operating conditions.

C. When reconnecting existing circuits to new panels, individually turn on each circuit while using a current indicating meter on the equipment grounding conductor. This is to check the individual branch circuits' current flow on the E.G.C.. If current flow is found on the E.G.C., investigate the circuit to find why this current flow exists (parallel neutral path, conduit with no E.G.C., etc.), and notify the Owner/Architect/Engineer of this problem to be properly addressed in a bulletin.

D. All permanent electrical equipment operated during construction periods shall be cleaned and damaged equipment replaced.

3.11 ADJUSTMENTS AND BALANCING:

A. Contractor shall make all necessary adjustments to equipment installed or connected by him under this contract so as to ensure proper operation of the same.

3.12 GUARANTEES AND WARRANTIES:

A. All labor, materials and equipment shall be guaranteed by Contractor and/or warranted by Manufacturer for one year after acceptance date and/or one normal continuous complete

seasons operation applicable to equipment or system except where specified longer for special equipment. Contractor shall secure such warranty from all Suppliers (not one year from shipment date), or Contractor to assume warranty.

B. Acceptance date of substantial completion shall be Owner occupancy as determined by Architect/Engineer.

C. Contractor shall make all necessary alterations, repairs, adjustments, replacements during guarantee periods as directed by Architect/Engineer to comply with Drawings and Specifications at no cost to Owner.

D. Repair or replacements made under guarantee bear further one year guarantee from date of acceptance of repair or replacement.

3.13 IDENTIFICATION:

A. All service switches, motor disconnects, controllers, etc., whether or not furnished under this Division shall be marked to identify the equipment served and the origin of the power source. Distribution panels, branch panels and switchboards shall be identified as to the designation indication on the Contract Drawings and voltage characteristics. Individual switches in Distribution Panels and Switchboards shall be identified as to equipment being fed.

B. All identification shall be done with engraved 5-ply lamacoid plates with ¼" white lettering on a black background. "Dymo" or tape markers ARE NOT acceptable.

C. Concisely and clearly type out all branch panel schedules indicating room or area served along with the item(s) connected to each circuit.

D. See Electrical Drawing Detail for additional identification requirements.

3.14 TRAINING:

A. The option of video taping any and all training sessions shall be given to the Owner at no additional cost, with the Contractor conducting the video taping and with two (2) copies of all tapes being turned over to the Owner for future use.

B. E.C. shall conduct 2 - 4 hour training session on the operation and controls of all electrical equipment. Notify owner 72 hours prior to session.

END OF SECTION

SECTION 26 00 10
ELECTRICAL EQUIPMENT AND MATERIALS

PART 1 GENERAL

1.01 INSTRUCTION:

A. The Contractor is to either copy or remove this specification section from the spec book and complete as follows:
   1. Indicate the specific manufacturer on which the bidder's base bid price is based in the blank space provided.
   2. All equipment is to be bid as specified. Material or equipment from another manufacturer may be bid as a Voluntary Alternate, but the dollar amount must be shown as an "Add" or "Deduct" to the base bid. Provide the name of the alternate manufacturer in the space provided.
   3. Insert the name(s) of each subcontractor used in your bid in the space provided in Part 3.
   4. This form shall be submitted with the bid.

1.02 RELATED DOCUMENTS:

A. The other Contract Documents complement the requirements of this Section. The General Requirements apply to the work of this section.

1.03 DEVIATIONS FROM SPECIFIED MATERIAL:

A. See Section 26 00 00, Part 2, Paragraph 2.02 - Substitutions and Changes. Base bid shall be based on manufacturers listed in this specification or on the drawings.

PART 2 PRODUCTS

2.01 THE FOLLOWING IS A LIST OF APPROVED MANUFACTURERS, GROUPED ACCORDING TO TYPES OF MATERIALS OR EQUIPMENT.

A. Wiring Devices:
   1. Pass & Seymour, Hubbell, Leviton, and Cooper

B. Motor Starters/Contactors:
   1. Square D (basis of design) or pre-approved equal

C. Branch Panels:
   1. Square D (basis of design) or pre-approved equal

D. Safety Switches:
   1. Square D (basis of design) or pre-approved equal

E. Dry Type Transformers:
   1. Square D (basis of design) or pre-approved equal

F. Gas Detection System
   1. Drager or pre-approved equal

G. Lighting Fixtures:
   1. Tag A: LDPI, Dialight, and Rig-A-Lite
   2. Tag B: Lithonia and Cooper
   3. Tag C: Lithonia and Cooper

PART 3 SUBCONTRACTORS

3.01 INSERT THE NAME OF EACH SUBCONTRACTOR AND WORK TO BE PERFORMED BELOW:

A. Subcontractor_____
   Work
   Performed_____

B. Subcontractor_____
   Work
   Performed_____

C. Subcontractor_____
Work
Performed_____

END OF SECTION

SECTION 26 00 50
BASIC MATERIALS AND METHODS

PART 1 GENERAL

1.01 MATERIALS:

A. All materials and equipment furnished for installation on this project shall be new and in strict accordance with Contract Documents. All packaged materials shall be delivered in their original containers which shall show the manufacturer's name and the identifying designations as to size, quality, etc. Materials delivered to the project unmarked or mutilated packages will be ordered to be removed from the site at once. Materials or equipment judged as "damaged" by the Architect/Engineer shall be removed from the project and site.

B. Should any dispute arise to the quality of any material, the decision shall rest entirely with the Architect/Engineer and shall be based on the requirement that all materials furnished shall be first class in every respect, and what is usual or customary in erecting other buildings shall in no way enter into the consideration or decision whatever as it pertains to the project under consideration.

C. All materials and equipment furnished under work of all Division 16 sections shall be UL approved and listed, and shall bear the Underwriter's Label.

1.02 SUBMITTALS:

A. Submit shop drawings for the following: (See 26 00 00 1.05 B 1 thru 6)
   1. Wiring devices.
   2. Motor starters/contactors.
   3. Branch circuit panelboards.
   4. Safety switches / breakers.
   5. Transformers.
   6. Indoor and outdoor light fixtures (See 26 51 00 1.03 A thru D).

PART 2 PRODUCTS

2.01 RACEWAYS:

A. Aluminum conduit is not acceptable in this Contract.

B. PVC Coated Metal Conduit.
   1. Description: NEMA RN 1; rigid steel conduit with external PVC coating, 40 mil (0.1 mm) thick.
   2. Fittings and Conduit Bodies: NEMA FB 1; steel fittings with external PVC coating to match conduit.

C. Rigid Metal Conduit:
   1. Rigid metal conduit shall be hot dipped galvanized steel, meeting Federal Standard WW-C-581.
   2. Threaded fittings shall be used on rigid metal conduit.

D. Electric Metallic Tubing:
   1. Electrical metallic tubing shall be standard weight, meeting Federal Standard WW- C-563 and bear the manufacturer's name and Underwriter's Label on each length. Maximum permissible size tubing shall be 4".
   2. Provide compression-type steel fittings or set screw-type steel fittings. Crimp-type connectors are not acceptable.

E. Flexible Metal Conduit:
   1. Flexible metallic conduit shall meet Federal Standard WW-C-566 and is to have separate grounding conductor. Minimum permissible size shall be 1/2".
   2. Fittings shall be malleable iron, threaded type.

F. Liquid-Tight Flexible Metal Conduit:
   1. Liquid-tight flexible metal conduit shall be single strip, flexible, continuous, interlocked, and double-wrapped steel. It shall be galvanized inside and outside, with a liquid-tight jacket of flexible polyvinyl chloride (PVC). Minimum permissible size shall be 1/2".
   2. Connectors shall be insulated throat, malleable iron.

G. Liquid-Tight Flexible Non-Metallic Conduit:
   1. Liquid-tight flexible non-metallic conduit shall be single strip, flexible polyvinyl chloride (PVC). Minimum permissible size shall be 1/2".
   2. Connectors shall be non-metallic (PVC) compression type UL labeled and listed to be used on liquid-tight flexible non-metallic conduit.

H. Rigid Non-Metallic Conduit:
   1. Rigid non-metallic conduit (PVC) shall be Schedule 40, rigid heavy wall polyvinyl chloride, 90 degrees C., UL rated.
   2. Fittings shall be solvent weld type of the same material as the conduit.
   3. All 45-degree bends or greater shall be made with rigid metal conduit fittings.

I. Wireways:
   1. Wireways shall be lay-in type and shall be UL listed as a wireway or auxiliary gutter. It shall be constructed with a hinged cover and knockouts. It shall be primed with a corrosion resistant primer and gray epoxy finish.

J. Metal-Clad Cable:
   1. Metal-Clad Cable is NOT acceptable in this project.

2.02 WIRE AND CABLE:

A. All wiring shall be copper and shall be installed in conduit or tubing unless specified otherwise.

B. All wire shall be new and in the original cartons or on manufacturer's shipping reels.

C. No wire smaller than #12 may be used unless specified under descriptions of special systems. Wire #10 and larger shall be stranded.

D. All branch circuit wiring shall be color coded black, red phases and white neutral for 120/240V, 1 phase, 3 wire system and brown, orange, yellow and white stripped neutral for 277/480V, 3 phase, 4 wire system. All grounding / bonding conductors shall be green or bare. Phase color consistent throughout the entire branch circuit system.

E. All neutral runs including feeders shall be white full length of conductor or identified per NEC.

F. Select from the following wire types to comply with the project's installation requirements and NEC standards.
   1. Type THHN/THWN rated installation. 600 volt, 90 degrees C., in conduit, stranded copper, size No. 12 AWG up to and including No. 10 AWG.
   2. Type THWN-2 rated insulation, 600 volt, 90 degrees C., in conduit, stranded copper, size No. 8 AWG up to No. 750 MCM AWG.

2.03 WIRE CONNECTORS AND JOINTS:

A. All conductors #8 AWG and smaller shall be joined with electrical spring connectors with vinyl insulating cap. Conductors larger than #8 shall be joined by compression type connectors.

B. **All connections and termination shall be made with Ideal "Nolox" anti-oxidizing paste.**

2.04 OUTLET BOXES:

A. Convenience outlet and switch boxes shall be a minimum 4"sq. x 2 1/8" deep with 1 or 2 gang, 2" deep plaster ring. When installed in poured walls, 3 1/8" minimum deep masonry box shall be used; when installed in masonry blocks, minimum 4"sq. x 2 1/8" deep with 1 or 2 gang, 2" deep plaster ring shall be used.

2.05 JUNCTION BOXES AND PULL BOXES:

A. When used, pull boxes and junction boxes shall be galvanized and have flat steel covers fastened with screws and set flush with the finished surface and located in an accessible area. When installed in damp locations, gaskets and seals shall be provided. Junction boxes shall be sized to meet N.E.C. Standards based on conduit and conductors. Provide identifying labels on each box.

2.06 WIRING DEVICES:

A. Receptacles:
   1. Receptacles shall be commercial specification grade. (All devices shall be WHITE in all other locations unless shown differently on plans)
      a. 20 Amp, 125 Volt, duplex, ground fault, weatherproof (NEMA 5-20R).
      b. 20 Amp, 125 Volt, duplex, ground fault (NEMA 5-20R).
      c. 20 Amp, 125 Volt, single (NEMA 5-20R).
      d. 20 Amp, 125 Volt, duplex (NEMA 5-20R).
      e. 30 Amp, 125/250 Volt (NEMA 14-30R).
      f. 50 Amp, 125/250 Volt (NEMA 14-50R).

B. Device Plates:
   1. Plates shall be brushed smooth stainless steel, except plates used on surface mounted boxes. Surface mounted outlets plates shall be raised, pressed metal type. Mounting screws shall be metal with same finish as plate and with countersunk head. Plates shall be single ganged, or combination, to accommodate arrangement indicated on drawings.

2.07 MOTOR CONTROLLERS:

A. 120 volt, less than 1/4hp:
   1. Provide motor toggle switch with heater, pilot light and lockout guard. Mount adjacent to motor. Size heater per NEC and manufacturer's recommendations. Based on Sq-D #FGJ5P (surface mount) or # FF1P FL1 (flush mount)

B. 120 volt, 1/3hp to 1hp:
   1. Provide NEMA rated combination magnetic motor starter and disconnect in appropriate enclosure with H.O.A. selector switch, red pilot light, 1 - N.O. & 1 - N.C. Aux. coil. Combination motor starter disconnect shall be Sq-D Class 8539 with breaker sized for respective motor load or two speed starters as shown on plans. Mount within sight and within 50' of motor. Size heaters per NEC and manufacturer's recommendations.

C. 208v, 1ph; 208v, 3ph; 480v. 1ph; and 480v, 3ph; 1/2hp or larger:
   1. Provide NEMA rated combination magnetic motor starter and disconnect in appropriate enclosure with H.O.A. selector switch, red pilot light, 120-volt control transformer, 1 - N.O. & 1 - N.C. Aux. coil. Combination motor starter disconnect shall be based on Sq-D Class 8539 with breaker sized for respective motor load or two speed starters as shown on plans. Mount within sight and within 50' of motor. Size heaters per NEC and manufacturer's recommendations.

2.08 BRANCH CIRCUIT PANELBOARDS:

A. Branch circuit panelboards shall be of the circuit breaker type with main lugs or main switch as indicated on drawings rated at 120/240 volts maximum, 1 phase, 3 wire AC capable of withstanding available fault current and be U.L. labeled and listed, surface or flush mounted, bottom or top fed with ground bar kits. Circuit breakers shall be system series rated. Panelboards shall be based on Square "D" type NQ.

2.09 FUSES:

A. Fuses 600 Amperes and Less: Dual element, current limiting, time delay, one-time fuse, 250 or 600 volt, UL Class J. Supply Owner with 3 - spare fuses of each size if applicable.

B. Fuses 601 Amperes and Larger: Current limiting, fast-acting, one time fuse, 600 volt, UL Class L. Supply Owner with 1 - spare fuse of each size if applicable.

C. Interrupting Rating: 200,000 rms amperes.

2.10 SAFETY SWITCHES:

A. Furnish and install all required safety switches.

B. Safety switches shall be NEMA heavy duty type "HD", fusible or non-fusible as shown on drawings and be U.L. labeled and listed. Switches shall be furnished in NEMA-1 general purpose dry location enclosures unless otherwise shown on drawings. Weatherproof switches shall be NEMA-3R (raintight).

C. Switches shall be horsepower rated with interlocking provisions to prevent unauthorized opening of the switch covers in the "ON" position. Switches shall be capable of being physically locked in the open (off) position.

D. Switches shall be Sq-D type "HD" 250v or 600v, respectively.

PART 3 EXECUTION

3.01 RACEWAYS:

A. Conduit or tubing shall be installed in a manner which complies with all applicable provisions of the National Electrical Code and at least six inches from parallel runs of steam pipes, flues, or hot water pipes.

B. Ends of all conduit or tubing shall terminate in a bushing or fitting having factory installed insulating liners. Provide plastic bushings on all conduit or tubing with wire larger than #4 AWG. Exposed runs shall be supported by hangers, clamps, or straps secured by toggle bolts in hollow construction or expansion bolts or inserts in poured or brick walls. No lead anchors shall be allowed

C. Every precaution shall be taken to protect the conduit from damage and from water, dirt, concrete, etc.., getting into the system during construction. Capped bushings shall be used on all conduit terminations until wire is installed. If, in the opinion of the Engineer, conduit or tubing has become damaged or contains unremovable foreign matter, it shall be replaced at the Contractor's expense.

D. Rigid metal conduit shall be used in all poured construction, fill, outside masonry walls, areas exposed to weather, under drives and walks, and in areas where tubing may become damaged.

E. Rigid non-metallic conduit (PVC) may be used in lieu of rigid metal conduit below grade or where concealed in concrete. Provide a separate bare stranded copper grounding conductor in the raceway sized in accordance with Table 250.122 of the NEC.

F. Electrical metallic conduit (EMT) shall be used for feeders and branch circuits above ground & above suspended accessible ceilings; for switch and receptacle legs which terminate above suspended accessible ceilings; for exposed feeders and branch circuits; for switch legs in moveable partitions.

G. Flexible metal conduit shall be used for connections to the following equipment: lighting fixtures only. Maximum length of flexible metallic conduit shall be 6'-0". Longer length may be permitted at the discretion of the Owner or as indicated on the plans. Minimum size shall be ½". Flexible metal conduit used for lighting fixture connections shall be "Greenfield" type. Fittings shall be insulated throat, flex-steel connectors.

H. Use liquid-tight flexible steel conduit and liquid-tight flexible non-metallic conduit for final connections to all indoor and outdoor motors and mechanical equipment with a length not to exceed 36".

I. At all wall penetrations, space around circuits shall be filled with mortar or other approved filler. Penetrations through walls, floors or ceilings must not alter the fire rating of the assembly.

J. Install from each recessed branch panel, four (4) 1" conduits to the nearest accessible ceiling space for future branch wiring. Identify such conduits above the ceiling.

K. All conduit and boxes shall be flush mounted and concealed. No exposed conduit will be allowed, except in electrical and mechanical spaces, and where specifically noted.

3.02 WIRE AND CABLE:

A. All wiring shall be installed in approved raceways. Conductors shall be continuous between outlets or junction boxes with splice made only within such boxes.

B. Any branch circuits over 50 feet in length shall be installed with one wire size larger than the circuit rating. Example: 1P/20amp breaker with #12 THHN wire run 50'+ shall be increased to a #10 THHN wire.

C. **All connections and terminations shall be made with Ideal "Nolox" anti-oxidizing paste**.

3.03 OUTLET BOXES:

A. A standard galvanized outlet box shall be installed for each and every outlet shown.

B. Set boxes squarely with faces flush to finished surfaces. The exact location of all outlets shall be approved by the Architect/Engineer before same are place and Contractor shall consult Architect/Engineer at all times relative to the location of outlets. No outlets shall be placed behind plumbing or heating pipes or where they will interfere with ducts, pipes, equipment, or other work.

C. Each outlet shall be rigidly supported from the building construction (independent of the raceway system).

3.04 WIRING DEVICES:

A. Receptacles shall be mounted approximately 18" above floor or at other heights indicated on drawings.

B. E.C. shall be responsible for protection of receptacles from painting, plastering, etc.

C. Wall switches shall be mounted approximately 4'-0" above floor unless they interfere with wainscoting or trim.

D. E.C. shall be responsible for masking switches for protection from painting, plastering, etc.

E. E.C. shall confirm all door swings with Contractor before installing switches.

F. Wall plates shall be installed plumb and level with all edges in contact with attaching surface.

G. E.C. shall confirm all ADA and barrier free requirements are meant and install according to their regulations.

3.05 SUPPORTS AND HANGERS:

A. Provide and install necessary steel brackets, rods, clamps, etc., for support of all work under this contract. All supports shall be plated or painted and shall be secured to structural members after Architect's approval.

3.06 SLEEVES AND INSERTS:

A. The Contractor shall be responsible for the proper location of all sleeves, chases, openings and inserts for the installation of his equipment.

B. Holes through walls, floors or structural members shall be located only where permitted by the Architect.

3.07 UNDERGROUND WORK:

A. Prior to any underground excavating, trenching, pole base augering, etc. call MISS DIG at 1-800-482-7171 no less than 72 hours in advance of any earthwork.

END OF SECTION

SECTION 26 05 19
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Single conductor building wire.

B. Wiring connectors.

C. Electrical tape.

D. Oxide inhibiting compound.

E. Wire pulling lubricant.

F. Cable ties.

1.02 RELATED REQUIREMENTS

A. Section 07 84 00 - Firestopping.

B. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire 2013 (Reapproved 2018).

B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft 2011 (Reapproved 2017).

C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes 2010, with Editorial Revision (2020).

D. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation 2004 (Reapproved 2020).

E. ASTM B800 - Standard Specification for 8000 Series Aluminum Alloy Wire for Electrical Purposes - Annealed and Intermediate Tempers 2005 (Reapproved 2021).

F. ASTM B801 - Standard Specification for Concentric-Lay-Stranded Conductors of 8000 Series Aluminum Alloy Wire for Subsequent Covering of Insulation 2018.

G. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape 2017.

H. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.

I. NECA 104 - Recommended Practice for Installing Aluminum Building Wire and Cable 2012.

J. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy 2021.

K. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

L. UL 44 - Thermoset-Insulated Wires and Cables Current Edition, Including All Revisions.

M. UL 83 - Thermoplastic-Insulated Wires and Cables Current Edition, Including All Revisions.

N. UL 486A-486B - Wire Connectors Current Edition, Including All Revisions.

O. UL 486C - Splicing Wire Connectors Current Edition, Including All Revisions.

P. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape Current Edition, Including All Revisions.

PART 2 PRODUCTS

2.01 CONDUCTOR AND CABLE APPLICATIONS

A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.

B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.

C. Nonmetallic-sheathed cable is not permitted.

D. Underground feeder and branch-circuit cable is not permitted.

E. Service entrance cable is not permitted.

F. Armored cable is not permitted.

G. Metal-clad cable is not permitted.

2.02 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

A. Provide products that comply with requirements of NFPA 70.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.

D. Comply with NEMA WC 70.

E. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.

F. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.

G. Conductor Material:
   1. Provide copper conductors only. Aluminum conductors are not acceptable for this project. Conductor sizes indicated are based on copper.
   2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B787M unless otherwise indicated.
   3. Tinned Copper Conductors: Comply with ASTM B33.

H. Minimum Conductor Size:
   1. Branch Circuits: 12 AWG.
   2. Control Circuits: 14 AWG.

I. Conductor Color Coding:
   1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
   2. Color Coding Method: Integrally colored insulation.
   3. Color Code:
      a. 480Y/277 V, 3 Phase, 4 Wire System:
         1) Phase A: Brown.
         2) Phase B: Orange.
         3) Phase C: Yellow.
         4) Neutral/Grounded: Gray.
      b. 240/120 V, 1 Phase, 3 Wire System:
         1) Phase A: Black.
         2) Phase B: Red.
         3) Neutral/Grounded: White.
      c. Equipment Ground, All Systems: Green.

2.03 SINGLE CONDUCTOR BUILDING WIRE

A. Description: Single conductor insulated wire.

B. Conductor Stranding:
   1. Feeders and Branch Circuits:
      a. Size 10 AWG and Smaller: Solid.
      b. Size 8 AWG and Larger: Stranded.

C. Insulation Voltage Rating: 600 V.

D. Insulation:
   1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2, except as indicated below.

2.04 WIRING CONNECTORS

A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.

2.05 ACCESSORIES

A. Electrical Tape:
   1. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil (0.18 mm); resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F (-18 degrees C) and suitable for continuous temperature environment up to 221 degrees F (105 degrees C).

B. Oxide Inhibiting Compound: Listed; suitable for use with the conductors or cables to be installed.

C. Wire Pulling Lubricant: Listed; suitable for use with the conductors or cables to be installed and suitable for use at the installation temperature.

D. Cable Ties: Material and tensile strength rating suitable for application.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that interior of building has been protected from weather.

B. Verify that work likely to damage wire and cable has been completed.

C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.

D. Verify that field measurements are as indicated.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

3.03 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Installation in Raceway:
   1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
   2. Pull all conductors and cables together into raceway at same time.
   3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
   4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.

D. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.

E. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.

F. Install conductors with a minimum of 12 inches (300 mm) of slack at each outlet.

G. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.

H. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.

I. Make wiring connections using specified wiring connectors.
   1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.
   2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking, or damaging conductors.
   3. Do not remove conductor strands to facilitate insertion into connector.
   4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.
   5. Connections for Aluminum Conductors: Fill connectors with oxide inhibiting compound where not pre-filled by manufacturer.

J. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.

K. Insulate ends of spare conductors using vinyl insulating electrical tape.

L. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.

M. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

END OF SECTION

SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Grounding and bonding requirements.

B. Conductors for grounding and bonding.

C. Connectors for grounding and bonding.

D. Ground bars.

E. Ground rod electrodes.

1.02 REFERENCE STANDARDS

A. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System 2012.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.

C. NEMA GR 1 - Grounding Rod Electrodes and Grounding Rod Electrode Couplings 2017.

D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems 2017.

E. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

F. UL 467 - Grounding and Bonding Equipment Current Edition, Including All Revisions.

1.03 SUBMITTALS

A. Product Data: Provide for grounding electrodes and connections.

B. Test Reports: Indicate overall resistance to ground and resistance of each electrode.

C. Project Record Documents: Record actual locations of components and grounding electrodes.

D. Certificate of Compliance: Indicate approval of installation by authority having jurisdiction.

1.04 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

B. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.01 GROUNDING AND BONDING REQUIREMENTS

A. Do not use products for applications other than as permitted by NFPA 70 and product listing.

B. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.

C. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

D. Grounding System Resistance:
   1. Achieve specified grounding system resistance under normally dry conditions unless otherwise approved by Engineer. Precipitation within the previous 48 hours does not constitute normally dry conditions.
   2. Grounding Electrode System: Not greater than 5 ohms to ground, when tested according to IEEE 81 using "fall-of-potential" method.

E. Grounding Electrode System:
   1. Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.
      a. Provide continuous grounding electrode conductors without splice or joint.
      b. Install grounding electrode conductors in raceway where exposed to physical damage. Bond grounding electrode conductor to metallic raceways at each end with bonding jumper.
   2. Metal Underground Water Pipe(s):
      a. Provide connection to underground metal domestic and fire protection (where present) water service pipe(s) that are in direct contact with earth for at least 10 feet (3.0 m) at an accessible location not more than 5 feet (1.5 m) from the point of entrance to the building.
      b. Provide bonding jumper(s) around insulating joints/pipes as required to make pipe electrically continuous.
      c. Provide bonding jumper around water meter of sufficient length to permit removal of meter without disconnecting jumper.
   3. Metal In-Ground Support Structure:
      a. Provide connection to metal in-ground support structure that is in direct contact with earth in accordance with NFPA 70.
   4. Concrete-Encased Electrode:
      a. Provide connection to concrete-encased electrode consisting of not less than 20 feet (6.0 m) of either steel reinforcing bars or bare copper conductor not smaller than 4 AWG embedded within concrete foundation or footing that is in direct contact with earth in accordance with NFPA 70.
   5. Ground Rod Electrode(s):
      a. Provide three electrodes in an equilateral triangle configuration unless otherwise indicated or required.
      b. Space electrodes not less than 10 feet (3.0 m) from each other and any other ground electrode.
   6. Provide additional ground electrode(s) as required to achieve specified grounding electrode system resistance.

F. Separately Derived System Grounding:
   1. Separately derived systems include, but are not limited to:
      a. Transformers (except autotransformers such as buck-boost transformers).
   2. Provide grounding electrode conductor to connect derived system grounded conductor to nearest effectively grounded metal building frame. Unless otherwise indicated, make connection at neutral (grounded) bus in source enclosure.
   3. Provide bonding jumper to connect derived system grounded conductor to nearest metal building frame and nearest metal water piping in the area served by the derived system, where not already used as a grounding electrode for the derived system. Make connection at same location as grounding electrode conductor connection.
   4. Provide system bonding jumper to connect system grounded conductor to equipment ground bus. Make connection at same location as grounding electrode conductor connection. Do not make any other connections between neutral (grounded) conductors and ground on load side of separately derived system disconnect.
   5. Where the source and first disconnecting means are in separate enclosures, provide supply-side bonding jumper between source and first disconnecting means.

G. Bonding and Equipment Grounding:
   1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.

2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.
6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.

H. Communications Systems Grounding and Bonding:
1. Provide intersystem bonding termination at service equipment or metering equipment enclosure and at disconnecting means for any additional buildings or structures in accordance with NFPA 70.
2. Provide bonding jumper in raceway from intersystem bonding termination to each communications room or backboard and provide ground bar for termination.
a. Bonding Jumper Size: 6 AWG, unless otherwise indicated or required.
b. Raceway Size: 3/4 inch (21 mm) trade size unless otherwise indicated or required.
c. Ground Bar Size: 1/4 by 2 by 12 inches (6 by 50 by 300 mm) unless otherwise indicated or required.

2.02 GROUNDING AND BONDING COMPONENTS

A. General Requirements:
1. Provide products listed, classified, and labeled as suitable for the purpose intended.
2. Provide products listed and labeled as complying with UL 467 where applicable.

B. Conductors for Grounding and Bonding, in Addition to Requirements of Section 26 05 26:
1. Use insulated copper conductors unless otherwise indicated.
a. Exceptions:
1) Use bare copper conductors where installed underground in direct contact with earth.
2) Use bare copper conductors where directly encased in concrete (not in raceway).

C. Connectors for Grounding and Bonding:
1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.
3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.

D. Ground Bars:
1. Description: Copper rectangular ground bars with mounting brackets and insulators.
2. Size: As indicated.
3. Holes for Connections: As indicated or as required for connections to be made.

E. Ground Rod Electrodes:
1. Comply with NEMA GR 1.
2. Material: Copper-bonded (copper-clad) steel.
3. Size: 3/4 inch (19 mm) diameter by 10 feet (3.0 m) length, unless otherwise indicated.
4. Where rod lengths of greater than 10 feet (3.0 m) are indicated or otherwise required, sectionalized ground rods may be used.

F. Foundation Electrodes: minimum size 4 AWG.

2.03 EQUIPMENT GROUNDING CONDUCTORS

A. Install a green equipment grounding conductor sized per N.E.C. 250-95 in ALL conduit. Conduit shall not be relied on for equipment grounding.

B. Wire: As shown on plans.

C. Grounding Electrode Conductor: Size to meet NFPA 70 requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that work likely to damage grounding and bonding system components has been completed.

B. Verify that field measurements are as indicated.

C. Verify that conditions are satisfactory for installation prior to starting work.

D. Verify that final backfill and compaction has been completed before driving rod electrodes.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Ground Rod Electrodes: Unless otherwise indicated, install ground rod electrodes vertically. Where encountered rock prohibits vertical installation, install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70 or install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70.

D. Make grounding and bonding connections using specified connectors.
   1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking, or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.
   2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
   3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
   4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
   5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

E. Identify grounding and bonding system components in accordance with Section 26 05 53.

F. Install ground electrodes & building steel at locations indicated. Install bonding jumper to internal building metallic water piping system. Install additional rod electrodes and/or building steel columns as required to achieve specified resistance to ground (5 ohms) or less. Install additional rod electrodes as required to achieve specified resistance to ground.

G. Provide grounding electrode conductor and connect to reinforcing steel in foundation footing where indicated. Bond steel together.

H. Provide bonding to meet requirements described in Quality Assurance.

I. Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.

3.03 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Perform inspection in accordance with Section 01 40 00.

C. Inspect and test in accordance with NETA ATS except Section 4.

D. Perform inspections and tests listed in NETA ATS, Section 7.13.

E. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.

F. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.

END OF SECTION

SECTION 26 05 33.13
CONDUIT FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Galvanized steel rigid metal conduit (RMC).
B. PVC-coated galvanized steel rigid metal conduit (RMC).
C. Flexible metal conduit (FMC).
D. Liquidtight flexible metal conduit (LFMC).
E. Electrical metallic tubing (EMT).
F. Rigid polyvinyl chloride (PVC) conduit.
G. Liquidtight flexible nonmetallic conduit (LFNC).
H. Conduit fittings.

1.02 RELATED REQUIREMENTS

A. Section 07 84 00 - Firestopping.
B. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
C. Section 26 05 53 - Identification for Electrical Systems.
D. Section 26 05 33.16 - Boxes for Electrical Systems.
E. Section 31 23 16 - Excavation.
F. Section 31 23 23 - Fill: Bedding and backfilling.

1.03 REFERENCE STANDARDS

A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC) 2015.
B. ANSI C80.3 - American National Standard for Electrical Metallic Tubing -- Steel (EMT-S) 2015.
C. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
D. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT) 2013.
E. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC) 2017.
F. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable 2014.
G. NEMA RN 1 - Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit 2018.
H. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit 2020.
I. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing 2021.
J. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
K. UL 1 - Flexible Metal Conduit Current Edition, Including All Revisions.
L. UL 6 - Electrical Rigid Metal Conduit-Steel Current Edition, Including All Revisions.
M. UL 360 - Liquid-Tight Flexible Steel Conduit Current Edition, Including All Revisions.
N. UL 514B - Conduit, Tubing, and Cable Fittings Current Edition, Including All Revisions.
O. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings Current Edition, Including All Revisions.
P. UL 797 - Electrical Metallic Tubing-Steel Current Edition, Including All Revisions.
Q. UL 1660 - Liquid-Tight Flexible Nonmetallic Conduit Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. Project Record Documents: Accurately record actual routing of conduits larger than 2 inches (51 mm).

1.05 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for purpose specified and shown.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 CONDUIT REQUIREMENTS

A. Provide all conduit, fittings, supports, and accessories required for a complete raceway system.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.02 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

A. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.

B. Fittings:
   1. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
   2. Hazardous (Classified) Locations: Use fittings listed and labeled as complying with UL 1203 for the classification of the installed location.
   3. Material: Use steel or malleable iron.
   4. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.03 PVC-COATED GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

A. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit with external polyvinyl chloride (PVC) coating complying with NEMA RN 1 and listed and labeled as complying with UL 6.

B. Exterior Coating: Polyvinyl chloride (PVC), nominal thickness of 40 mil (1.02 mm).

C. PVC-Coated Fittings:
   1. Manufacturer: Same as manufacturer of PVC-coated conduit to be installed.
   2. Non-Hazardous Locations: Use fittings listed and labeled as complying with UL 514B.
   3. Hazardous (Classified) Locations: Use fittings listed and labeled as complying with UL 1203 for the classification of the installed location.
   4. Material: Use steel or malleable iron.
   5. Exterior Coating: Polyvinyl chloride (PVC), minimum thickness of 40 mil (1.02 mm).

D. PVC-Coated Supports: Furnish with exterior coating of polyvinyl chloride (PVC), minimum thickness of 15 mil (0.38 mm).

2.04 FLEXIBLE METAL CONDUIT (FMC)

A. Description: NFPA 70, Type FMC standard wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems to be used.

B. Fittings:
   1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
   2. Material: Use steel or malleable iron.

2.05 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

A. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.

B. Fittings:
   1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
   2. Material: Use steel or malleable iron.

2.06 ELECTRICAL METALLIC TUBING (EMT)

A. Description: NFPA 70, Type EMT steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.

B. Fittings:
   1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
   2. Material: Use steel or malleable iron.
   3. Connectors and Couplings: Use compression (gland) or set-screw type.
      a. Do not use indenter type connectors and couplings.

2.07 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

A. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage; rated for use with conductors rated 90 degrees C.

B. Fittings:
   1. Manufacturer: Same as manufacturer of conduit to be connected.
   2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.

2.08 LIQUIDTIGHT FLEXIBLE NONMETALLIC CONDUIT (LFNC)

A. Description: NFPA 70, Type LFNC liquidtight flexible nonmetallic conduit listed and labeled as complying with UL 1660.

B. Fittings:
   1. Manufacturer: Same as manufacturer of conduit to be connected.
   2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B; suitable for the type of conduit to be connected.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive conduits.

C. Verify that conditions are satisfactory for installation prior to starting work.

D. Verify routing and termination locations of conduit prior to rough-in.

E. Conduit routing is shown on drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Install galvanized steel rigid metal conduit (RMC) in accordance with NECA 101.

D. Install PVC-coated galvanized steel rigid metal conduit (RMC) using only tools approved by the manufacturer.

E. Install rigid polyvinyl chloride (PVC) conduit in accordance with NECA 111.

F. Install liquidtight flexible nonmetallic conduit (LFNC) in accordance with NECA 111.

G. Conduit Routing:
   1. Unless dimensioned, conduit routing indicated is diagrammatic.
   2. When conduit destination is indicated without specific routing, determine exact routing required.
   3. Conduits installed underground or embedded in concrete may be routed in the shortest possible manner unless otherwise indicated. Route all other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.
   4. Arrange conduit to maintain adequate headroom, clearances, and access.
   5. Arrange conduit to provide no more than the equivalent of four 90 degree bends between pull points.
   6. Arrange conduit to provide no more than 150 feet (46 m) between pull points.
   7. Route conduits above water and drain piping where possible.
   8. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
   9. Maintain minimum clearance of 6 inches (150 mm) between conduits and piping for other systems.
   10. Maintain minimum clearance of 12 inches (300 mm) between conduits and hot surfaces. This includes, but is not limited to:
   11. Group parallel conduits in the same area together on a common rack.

H. Conduit Support:
   1. Secure and support conduits in accordance with NFPA 70 and Section 26 05 29 using suitable supports and methods approved by the authority having jurisdiction.
   2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
   3. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.
   4. Use conduit strap to support single surface-mounted conduit.
      a. Use clamp back spacer with conduit strap for damp and wet locations to provide space between conduit and mounting surface.
   5. Use metal channel (strut) with accessory conduit clamps to support multiple parallel surface-mounted conduits.
   6. Use trapeze hangers assembled from threaded rods and metal channel (strut) with accessory conduit clamps to support multiple parallel suspended conduits.
   7. Where conduit support intervals specified in NFPA 70 and NECA standards differ, comply with the most stringent requirements.

I. Connections and Terminations:
   1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
   2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
   3. Use suitable adapters where required to transition from one type of conduit to another.
   4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
   5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.

6. Provide insulating bushings or insulated throats at all conduit terminations to protect conductors.
7. Secure joints and connections to provide maximum mechanical strength and electrical continuity.

J. Penetrations:
1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
2. Make penetrations perpendicular to surfaces unless otherwise indicated.
3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.
4. Conceal bends for conduit risers emerging above ground.
5. Seal interior of conduits entering the building from underground at first accessible point to prevent entry of moisture and gases.
6. Provide suitable modular seal where conduits penetrate exterior wall below grade.
7. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
8. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty. Include proposed locations of penetrations and methods for sealing with submittals.
9. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.

K. Underground Installation:
1. Provide trenching and backfilling in accordance with Sections 31 23 16 and 31 23 16.

L. Concrete Encasement: Where conduits not otherwise embedded within concrete are indicated to be concrete-encased, provide concrete in accordance with Section 03 30 00 with minimum concrete cover of 3 inches (76 mm) on all sides unless otherwise indicated.

M. Hazardous (Classified) Locations: Where conduits cross boundaries of hazardous (classified) locations, provide sealing fittings located as indicated or in accordance with NFPA 70.

N. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
2. Where calculated in accordance with NFPA 70 for rigid polyvinyl chloride (PVC) conduit installed above ground to compensate for thermal expansion and contraction.
3. Where conduits are subject to earth movement by settlement or frost.

O. Condensation Prevention: Where conduits cross barriers between areas of potential substantial temperature differential, provide sealing fitting or approved sealing compound at an accessible point near the penetration to prevent condensation. This includes, but is not limited to:
1. Where conduits pass from outdoors into conditioned interior spaces.
2. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.

P. Provide pull string in all empty conduits and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 12 inches (300 mm) at each end.

Q. Provide grounding and bonding in accordance with Section 26 05 26.

3.03 CLEANING

A. Clean interior of conduits to remove moisture and foreign matter.

3.04 INTERFACE WITH OTHER PRODUCTS

A. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.

B. Route conduit through roof openings for piping and ductwork wherever possible. Where separate roofing penetration is required, coordinate location and installation method with roofing installation.

END OF SECTION

SECTION 26 05 33.16
BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Outlet and device boxes up to 100 cubic inches (1,650 cu cm), including those used as junction and pull boxes.

B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches (1,650 cu cm).

C. Boxes for hazardous (classified) locations.

D. Underground boxes/enclosures.

1.02 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete.

B. Section 07 84 00 - Firestopping.

C. Section 26 05 26 - Grounding and Bonding for Electrical Systems.

D. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

E. Section 26 27 26 - Wiring Devices:
   1. Wall plates.

1.03 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.

B. NECA 130 - Standard for Installing and Maintaining Wiring Devices 2010.

C. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable 2014.

D. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports 2013.

E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.

F. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

G. SCTE 77 - Specification for Underground Enclosure Integrity 2017.

H. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations Current Edition, Including All Revisions.

I. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations Current Edition, Including All Revisions.

J. UL 508A - Industrial Control Panels Current Edition, Including All Revisions.

K. UL 514A - Metallic Outlet Boxes Current Edition, Including All Revisions.

L. UL 1203 - Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations Current Edition, Including All Revisions.

1.04 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

B. Products: Provide products listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.01 BOXES

A. General Requirements:
   1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
   2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
   3. Provide products listed, classified, and labeled as suitable for the purpose intended.
   4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
   5. Provide grounding terminals within boxes where equipment grounding conductors terminate.

B. Outlet and Device Boxes Up to 100 cubic inches (1,650 cu cm), Including Those Used as Junction and Pull Boxes:
   1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
   2. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
   3. Use suitable concrete type boxes where flush-mounted in concrete.
   4. Use suitable masonry type boxes where flush-mounted in masonry walls.
   5. Use raised covers suitable for the type of wall construction and device configuration where required.
   6. Use shallow boxes where required by the type of wall construction.
   7. Do not use "through-wall" boxes designed for access from both sides of wall.
   8. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
   9. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
   10. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.
   11. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes unless specifically indicated or permitted.
   12. Wall Plates: Comply with Section 26 27 26.

C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches (1,650 cu cm):
   1. Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
   2. NEMA 250 Environment Type, Unless Otherwise Indicated:
   3. Junction and Pull Boxes Larger Than 100 cubic inches (1,650 cu cm):
      a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.

D. Boxes for Hazardous (Classified) Locations: Listed and labeled as complying with UL 1203 for the classification of the installed location.

E. Underground Boxes/Enclosures:
   1. Description: In-ground, open bottom boxes furnished with flush, non-skid covers with legend indicating type of service and stainless steel tamper resistant cover bolts.
   2. Size: As indicated on drawings.
   3. Depth: As required to extend below frost line to prevent frost upheaval, but not less than 12 inches (300 mm).
   4. Applications:
      a. Sidewalks and Landscaped Areas Subject Only to Occasional Nondeliberate Vehicular Traffic: Use polymer concrete enclosures, with minimum SCTE 77 Tier 8 load rating.

b. Parking Lots, in Areas Subject Only To Occasional Nondeliberate Vehicular Traffic: Use polymer concrete enclosures, with minimum SCTE 77 Tier 15 load rating.
c. Do not use polymer concrete enclosures in areas subject to deliberate vehicular traffic.

5. Polymer Concrete Underground Boxes/Enclosures: Comply with SCTE 77.
   a. Combination fiberglass/polymer concrete boxes/enclosures are acceptable.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive boxes.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install boxes in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Box Locations:
1. Locate boxes to be accessible. Provide access panels as required and where approved by the Architect.
2. Locate boxes so that wall plates do not span different building finishes.
3. Locate boxes so that wall plates do not cross masonry joints.
4. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line.
5. Do not install flush-mounted boxes on opposite sides of walls back-to-back. Provide minimum 6 inches (150 mm) horizontal separation unless otherwise indicated.

E. Box Supports:
1. Secure and support boxes in accordance with NFPA 70 and Section 26 05 29 using suitable supports and methods approved by the authority having jurisdiction.
2. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.

F. Install boxes plumb and level.

G. Flush-Mounted Boxes:
1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch (6 mm) or does not project beyond finished surface.
2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.
3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch (3 mm) at the edge of the box.

H. Install boxes as required to preserve insulation integrity.

I. Underground Boxes/Enclosures:
1. Install enclosure on gravel base, minimum 6 inches (150 mm) deep.
2. Flush-mount enclosures located in concrete or paved areas.

3. Mount enclosures located in landscaped areas with top at 1 inch (25 mm) above finished grade.
4. Provide cast-in-place concrete collar constructed in accordance with Section 03 30 00, minimum 10 inches wide by 12 inches deep (250 mm wide by 300 mm deep), around enclosures that are not located in concrete areas.
5. Install additional bracing inside enclosures in accordance with manufacturer's instructions to minimize box sidewall deflections during backfilling. Backfill with cover bolted in place.

J. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.

K. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.

L. Close unused box openings.

M. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.

N. Provide grounding and bonding in accordance with Section 26 05 26.

O. Identify boxes in accordance with Section 26 05 53.

3.03 CLEANING

A. Clean interior of boxes to remove dirt, debris, plaster, and other foreign material.

3.04 PROTECTION

A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

B. Clean exposed surfaces and restore finish.

END OF SECTION

SECTION 26 05 53
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical identification requirements.

B. Identification nameplates and labels.

C. Wire and cable markers.

D. Underground warning tape.

E. Warning signs and labels.

F. Field-painted identification of conduit and boxes.

1.02 REFERENCE STANDARDS

A. ANSI Z535.2 - American National Standard for Environmental and Facility Safety Signs 2011.

B. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels 2011.

C. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. UL 969 - Marking and Labeling Systems Current Edition, Including All Revisions.

1.03 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.04 FIELD CONDITIONS

A. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.

B. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for purpose specified and shown.

PART 2 PRODUCTS

2.01 IDENTIFICATION REQUIREMENTS

A. Identification for Equipment:
   1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
      a. Motor Control Centers:
         1) Identify ampere rating.
         2) Identify voltage and phase.
         3) Identify power source and circuit number. Include location when not within sight of equipment.
         4) Use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
      b. Panelboards:
         1) Identify ampere rating.
         2) Identify voltage and phase.
         3) Identify power source and circuit number. Include location when not within sight of equipment.
         4) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces using pencil.
         5) For power panelboards without a door, use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
      c. Transformers:
         1) Identify kVA rating.
         2) Identify voltage and phase for primary and secondary.

3) Identify power source and circuit number. Include location when not within sight of equipment.
4) Identify load(s) served. Include location when not within sight of equipment.

d. Enclosed switches, circuit breakers, and motor controllers:
1) Identify voltage and phase.
2) Identify power source and circuit number. Include location when not within sight of equipment.
3) Identify load(s) served. Include location when not within sight of equipment.

2. Available Fault Current Documentation: Use identification label to identify the available fault current and date calculations were performed at locations requiring documentation by NFPA 70 including but not limited to the following.
a. Service equipment.
b. Industrial control panels.
c. Motor control centers.
d. Elevator control panels.
e. Industrial machinery.

3. Arc Flash Hazard Warning Labels: Use warning labels to identify arc flash hazards for electrical equipment, such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers that are likely to require examination, adjustment, servicing, or maintenance while energized.
a. Legend: Include orange header that reads "WARNING", followed by the word message "Arc Flash and Shock Hazard; Appropriate PPE Required; Do not operate controls or open covers without appropriate personal protection equipment; Failure to comply may result in injury or death; Refer to NFPA 70E for minimum PPE requirements" or approved equivalent.

B. Identification for Conductors and Cables:
1. Color Coding for Power Conductors 600 V and Less: Comply with Section 26 05 19.
2. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.

C. Identification for Boxes:
1. Use voltage markers to identify highest voltage present.
2. Use identification labels or handwritten text using indelible marker to identify circuits enclosed.

D. Identification for Devices:
1. Use identification label or engraved wallplate to identify serving branch circuit for all receptacles.
a. For receptacles in public areas or in areas as directed by Architect, provide identification on inside surface of wallplate.
2. Use identification label to identify receptacles protected by upstream GFI protection, where permitted.

2.02 IDENTIFICATION NAMEPLATES AND LABELS

A. Identification Nameplates:
1. Materials:
a. Indoor Clean, Dry Locations: Use plastic nameplates.
b. Outdoor Locations: Use plastic, stainless steel, or aluminum nameplates suitable for exterior use.
2. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch (1.6 mm); engraved text.

3. Stainless Steel Nameplates: Minimum thickness of 1/32 inch (0.8 mm); engraved or laser-etched text.
4. Aluminum Nameplates: Anodized; minimum thickness of 1/32 inch (0.8 mm); engraved or laser-etched text.
5. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch (25 mm) high; Four, located at corners for larger sizes.

B. Identification Labels:
1. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
2. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.

C. Format for Equipment Identification:
1. Minimum Size: 1 inch (25 mm) by 2.5 inches (64 mm).
2. Legend:
a. Equipment designation or other approved description.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height:
a. Equipment Designation: 1/2 inch (13 mm).
b. Other Information: 1/4 inch (6 mm).
5. Color:
a. Normal Power System: White text on black background.

2.03 WIRE AND CABLE MARKERS

A. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, plastic sleeve, plastic clip-on, or vinyl split sleeve type markers suitable for the conductor or cable to be identified.

B. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.

C. Legend: Power source and circuit number or other designation indicated.

D. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.

E. Minimum Text Height: 1/8 inch (3 mm).

F. Color: Black text on white background unless otherwise indicated.

2.04 UNDERGROUND WARNING TAPE

A. Materials: Use non-detectable type polyethylene tape suitable for direct burial, unless otherwise indicated.

B. Non-detectable Type Tape: 6 inches (152 mm) wide, with minimum thickness of 4 mil (0.1 mm).

C. Legend: Type of service, continuously repeated over full length of tape.

D. Color:
1. Tape for Buried Power Lines: Black text on red background.
2. Tape for Buried Communication, Alarm, and Signal Lines: Black text on orange background.

2.05 WARNING SIGNS AND LABELS

A. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.

B. Warning Signs:
1. Materials:
a. Indoor Dry, Clean Locations: Use factory pre-printed rigid plastic or self-adhesive vinyl signs.
b. Outdoor Locations: Use factory pre-printed rigid aluminum signs.

2. Rigid Signs: Provide four mounting holes at corners for mechanical fasteners.
3. Minimum Size: 7 by 10 inches (178 by 254 mm) unless otherwise indicated.

C. Warning Labels:
1. Materials: Use factory pre-printed or machine-printed self-adhesive polyester or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.
2. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer.
3. Minimum Size: 2 by 4 inches (51 mm by 102 mm) unless otherwise indicated.

PART 3 EXECUTION

3.01 PREPARATION

A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:
1. Surface-Mounted Equipment: Enclosure front.
2. Flush-Mounted Equipment: Inside of equipment door.
3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
4. Elevated Equipment: Legible from the floor or working platform.
5. Branch Devices: Adjacent to device.
6. Interior Components: Legible from the point of access.
7. Boxes: Outside face of cover.
8. Conductors and Cables: Legible from the point of access.
9. Devices: Outside face of cover.

C. Install identification products centered, level, and parallel with lines of item being identified.

D. Secure nameplates to exterior surfaces of enclosures using stainless steel screws and to interior surfaces using self-adhesive backing or epoxy cement.

E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.

F. Install underground warning tape above buried lines with one tape per trench at 3 inches (75 mm) below finished grade.

G. Secure rigid signs using stainless steel screws.

H. Mark all handwritten text, where permitted, to be neat and legible.

END OF SECTION

SECTION 26 05 75
MANUFACTURER'S ENGINEERING SERVICES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

1.02 SUMMARY

A. This Section includes requirements for manufacturer's engineering services to assist in energizing and testing all busway and switchboard and providing breaker coordination and short circuit systems studies.

1.03 SUBMITTALS

A. System Coordination and Short Circuit Study Report: Submit six copies of final report. Report shall be submitted within 60 days following award of purchase order.

1.04 INSTALLATION AND SERVICE ENGINEERING

A. The manufacturer of the switchboard and busway shall provide an experienced Field Service Engineer to accomplish the following tasks:
   1. Inspection: Visually inspect all busway, switchboard and breakers upon completion of installation and prior to energization to assure that wiring is correct, interconnections complete and installation is in compliance with manufacturer's criteria.
   2. Provide engineering support during the energization and check out of busway and switchboard. Perform any calibration or adjustment necessary for the equipment to meet performance specifications.
   3. Field Service Engineer shall be at job site a minimum of 16 hours, and longer, if necessary, to fulfill testing/inspection requirements.

1.05 SYSTEM STUDIES

A. Perform the studies described below and submit 6 copies to Architect within 90 days after award of the contract. At time of submission, provide competent systems engineer to review findings and recommendations.
   1. Short Circuit Study: Shall be performed on a digital computer to check the adequacy and to verify correct application of circuit protective devices and other system components specified. Include representation of the power company's system, the base quantities selected, impedance source data, calculation methods and tabulations, one-line and impedance diagrams, conclusions, and recommendations. Short circuit momentary duties, when applicable, and interrupting duties shall be calculated on the basis of an assumed bolted three-phase short circuit at each low-voltage bus, switchboard, motor control center, distribution panelboard, pertinent branch circuit panelboard, and other significant locations throughout the systems. The short circuit tabulations shall include significant X to R ratios, asymmetry factors, kVA, and symmetrical fault current.
   2. Coordination Study: Provide a protective device time-current coordination study with coordination plots of key or limiting devices plus tabulated data including ratings or settings selected. In the study, a professional engineering balance shall be achieved between the competing objectives of protection and continuity of service for the system specified, taking into account the basic factors of sensitivity, selectivity, and speed. As applicable, the coordination plots required shall graphically indicate the coordination proposed for the several systems centered on full scale log forms. The coordination plots shall include complete titles, representative one-line diagrams and legends, associated power company's relay or system characteristics, significant motor starting characteristics, complete operating bands for low-voltage circuit breaker trip devices, fuses, as applicable, and the associated system load protective devices. The coordination plots shall define the types of protective devices selected, together with the proposed pick-up settings required. The short-time region shall indicate the low-voltage circuit breaker and

instantaneous trip devices, fuse manufacturing tolerance bands, and significant symmetrical and asymmetrical fault currents. Low-voltage power circuit breakers shall be separated from each other, where feasible, by a 16 percent current margin for coordination and protection in the event of secondary line-to-line faults.

3. Report: Include recommendations for changes in device short circuit ratings where deemed necessary. Include, in tabulated form, recommended device time delay and pick-up settings for switchboard breakers and for breakers with adjustable instantaneous trip range.

PART 2 PRODUCTS

2.01 NOT USED

PART 3 EXECUTION

3.01 NOT USED

END OF SECTION

SECTION 26 05 83
WIRING CONNECTIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical connections to equipment.

1.02 RELATED REQUIREMENTS

A. Section 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES.

B. Section 26 05 33.13 - Conduit for Electrical Systems.

C. Section 26 05 33.16 - Boxes for Electrical Systems.

D. Section 26 27 26 - Wiring Devices.

1.03 REFERENCE STANDARDS

A. NEMA WD 1 - General Color Requirements for Wiring Devices 1999 (Reaffirmed 2015).

B. NEMA WD 6 - Wiring Devices - Dimensional Specifications 2016.

C. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Products: Listed, classified, and labeled as suitable for the purpose intended.

1.05 COORDINATION

A. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.

B. Determine connection locations and requirements.

C. Sequence rough-in of electrical connections to coordinate with installation of equipment.

D. Sequence electrical connections to coordinate with start-up of equipment.

PART 2 PRODUCTS

2.01 MATERIALS

A. Cords and Caps: NEMA WD 6; match receptacle configuration at outlet provided for equipment.
   1. Colors: Comply with NEMA WD 1.
   2. Cord Construction: NFPA 70, Type SO, multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
   3. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

B. Wiring Devices: As specified in Section 26 27 26.

C. Flexible Conduit: As specified in Section 26 05 33.13.

D. Wire and Cable: As specified in Section 26 05 19.

E. Boxes: As specified in Section 26 05 33.16.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.02 ELECTRICAL CONNECTIONS

A. Make electrical connections in accordance with equipment manufacturer's instructions.

B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.

C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.

D. Provide receptacle outlet to accommodate connection with attachment plug.

E. Provide cord and cap where field-supplied attachment plug is required.

F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.

G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.

H. Install terminal block jumpers to complete equipment wiring requirements.

I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

END OF SECTION

SECTION 26 22 00
LOW-VOLTAGE TRANSFORMERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General purpose transformers.

1.02 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Concrete equipment pads.

B. Section 26 05 26 - Grounding and Bonding for Electrical Systems.

C. Section 26 05 33.13 - Conduit for Electrical Systems: Flexible conduit connections.

1.03 REFERENCE STANDARDS

A. 10 CFR 431, Subpart K - Energy Efficiency Program for Certain Commercial and Industrial Equipment - Distribution Transformers Current Edition.

B. IEEE C57.94 - IEEE Recommended Practice for Installation, Application, Operation, and Maintenance of Dry-Type Distribution and Power Transformers 2015.

C. IEEE C57.96 - IEEE Standard Guide for Loading Dry-Type Distribution and Power Transformers 2013.

D. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.

E. NECA 409 - Standard for Installing and Maintaining Dry-Type Transformers 2015.

F. NEMA ST 1 - Specialty Transformers (Except General Purpose Type); National Electrical Manufacturers Association; 1988 (R1997).

G. NEMA ST 20 - Dry-Type Transformers for General Applications 2014.

H. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.

I. NEMA TP 1 - Guide for Determining Energy Efficiency for Distribution Transformers; 2002.

J. NEMA TP 2 - Standard Test Method for Measuring the Energy Consumption of Distribution Transformers; 2005.

K. NEMA TP 3 - Standard for the Labeling of Distribution Transformer Efficiency; 2000.

L. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems 2017.

M. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

N. UL 506 - Standard for Specialty Transformers Current Edition, Including All Revisions.

O. UL 1561 - Standard for Dry-Type General Purpose and Power Transformers Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Include voltage, kVA, impedance, tap configurations, insulation system class and rated temperature rise, efficiency, sound level, enclosure ratings, outline and support point dimensions, weight, required clearances, service condition requirements, and installed features.

C. Source Quality Control Test Reports: Include reports for tests designated in NEMA ST 20 as design and routine tests.

D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

E. Project Record Documents: Record actual locations of transformers.

1.05 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

C. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Square D: www.squared.com.

B. Substitutions: See Section 26 00 10 - Electrical Equipment and Materials.

2.02 TRANSFORMERS - GENERAL REQUIREMENTS

A. Description: Factory-assembled, dry type transformers for 60 Hz operation designed and manufactured in accordance with NEMA ST 20 and listed, classified, and labeled as suitable for the purpose intended.

B. Unless noted otherwise, transformer ratings indicated are for continuous loading according to IEEE C57.96 under the following service conditions:
   1. Altitude: Less than 3,300 feet (1,000 m).
   2. Ambient Temperature:
      a. Greater than 10 kVA: Not exceeding 104 degrees F (40 degrees C).
      b. Less than 10 kVA: Not exceeding 77 degrees F (25 degrees C).
   3. Ambient Temperature: Not exceeding 86 degrees F (30 degrees C) average or 104 degrees F (40 degrees C) maximum measured during any 24 hour period.

C. Core: High grade, non-aging silicon steel with high magnetic permeability and low hysteresis and eddy current losses. Keep magnetic flux densities substantially below saturation point, even at 10 percent primary overvoltage. Tightly clamp core laminations to prevent plate movement and maintain consistent pressure throughout core length.

D. Impregnate core and coil assembly with non-hydroscopic thermo-setting varnish to effectively seal out moisture and other contaminants.

E. Basic Impulse Level: 10 kV.

F. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.

G. Isolate core and coil from enclosure using vibration-absorbing mounts.

H. Nameplate: Include transformer connection data, ratings, wiring diagrams, and overload capacity based on rated winding temperature rise.

2.03 GENERAL PURPOSE TRANSFORMERS

A. Description: Self-cooled, two winding transformers listed and labeled as complying with UL 506 or UL 1561; ratings as indicated on the drawings.

B. Primary Voltage: 480 volts delta, 3 phase.

C. Secondary Voltage: 120/208 volts, 3 phase.

D. Insulation System and Allowable Average Winding Temperature Rise:

1. Less than 15 kVA: Class 180 degrees C insulation system with 115 degrees C average winding temperature rise.
2. 15 kVA and Larger: Class 220 degrees C insulation system with 150 degrees C average winding temperature rise.

E. Coil Conductors: Continuous windings with terminations brazed or welded.

F. Winding Taps:
1. Less than 3 kVA: None.
2. 3 kVA through 15 kVA: Two 5 percent full capacity primary taps below rated voltage.
3. 15 kVA through 300 kVA: Two 2.5 percent full capacity primary taps above and four 2.5 percent full capacity primary taps below rated voltage.

G. Energy Efficiency: Comply with 10 CFR 431, Subpart K.
1. Test efficiency according to NEMA TP 2.
2. Label transformer according to NEMA TP 3.

H. Sound Levels: Standard sound levels complying with NEMA ST 20

I. Mounting Provisions:
1. Less than 15 kVA: Suitable for wall mounting.
2. 15 kVA through 75 kVA: Suitable for wall, floor, or trapeze mounting.
3. Larger than 75 kVA: Suitable for floor mounting.

J. Transformer Enclosure: Comply with NEMA ST 20.
1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
2. Construction: Steel.
   a. Less than 15 kVA: Totally enclosed, non-ventilated.
   b. 15 kVA and Larger: Ventilated.
3. Finish: Manufacturer's standard grey, suitable for outdoor installations.
4. Provide lifting eyes or brackets.

PART 3 EXECUTION

3.01 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).

B. Install products in accordance with manufacturer's instructions.

C. Install transformers in accordance with NECA 409 and IEEE C57.94.

D. Use flexible conduit, under the provisions of Section 26 05 33.13, 2 feet (600 mm) minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.

E. Arrange equipment to provide minimum clearances as specified on transformer nameplate and in accordance with manufacturer's instructions and NFPA 70.

F. Install transformers plumb and level.

G. Transformer Support:
1. Provide required support and attachment in accordance with Section 26 05 29, where not furnished by transformer manufacturer.
2. Use integral transformer flanges, accessory brackets furnished by manufacturer, or field-fabricated supports to support wall-mounted transformers.
3. Unless otherwise indicated, mount floor-mounted transformers on properly sized 3 inch (80 mm) high concrete pad constructed in accordance with Section 03 30 00.
4. Use trapeze hangers assembled from threaded rods and metal channel (strut) to support suspended transformers. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

H. Mount wall-mounted transformers using integral flanges or accessory brackets furnished by the manufacturer.

I. Mount floor-mounted transformers on properly sized 3 inch (80 mm) high concrete pad constructed in accordance with Section 03 30 00.

J. Mount floor-mounted transformers using vibration isolators suitable for isolating the transformer noise from the building structure.

K. Provide grounding and bonding in accordance with Section 26 05 26.

L. Remove shipping braces and adjust bolts that attach the core and coil mounting bracket to the enclosure according to manufacturer's recommendations in order to reduce audible noise transmission.

M. Where not factory-installed, install lugs sized as required for termination of conductors as indicated.

3.02 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Perform field inspection, testing, and adjusting in accordance with Section 01 40 00.

C. Inspect and test in accordance with NETA ATS, except Section 4.

D. Perform inspections and tests listed in NETA ATS Sections 7.2.1.1 and 7.2.1.2. Tests and inspections listed as optional are not required.

3.03 ADJUSTING

A. Measure primary and secondary voltages and make appropriate tap adjustments.

B. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

END OF SECTION

SECTION 26 24 16
PANELBOARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Power distribution panelboards.

B. Lighting and appliance panelboards.

C. Overcurrent protective devices for panelboards.

1.02 RELATED REQUIREMENTS

A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.

B. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service 2013e (Amended 2017).

B. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.

C. NECA 407 - Standard for Installing and Maintaining Panelboards 2015.

D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.

E. NEMA PB 1 - Panelboards 2011.

F. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less 2013.

G. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations Current Edition, Including All Revisions.

I. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations Current Edition, Including All Revisions.

J. UL 67 - Panelboards Current Edition, Including All Revisions.

K. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.

1. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.

B. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

C. Project Record Documents: Record actual installed locations of panelboards and actual installed circuiting arrangements.

1.05 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.06 MAINTENANCE MATERIALS

A. Furnish two of each panelboard key.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Schneider Electric; Square D Products; www.schneider-electric.us/#sle.

2.02 PANELBOARDS - GENERAL REQUIREMENTS

A. Provide products listed, classified, and labeled as suitable for the purpose intended.

B. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
   1. Altitude: Less than 6,600 feet (2,000 m).
   2. Ambient Temperature:
      a. Panelboards Containing Circuit Breakers: Between 23 degrees F (-5 degrees C) and 104 degrees F (40 degrees C).

C. Short Circuit Current Rating:
   1. Provide panelboards with listed short circuit current rating not less than the available fault current at the installed location as determined by short circuit study performed in accordance with Section 26 05 75.
   2. Listed series ratings are acceptable, except where not permitted by motor contribution according to NFPA 70.
   3. Label equipment utilizing series ratings as required by NFPA 70.

D. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.

E. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.

F. Bussing: Sized in accordance with UL 67 temperature rise requirements.
   1. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.

G. Conductor Terminations: Suitable for use with the conductors to be installed.

H. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
   1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
   2. Boxes: Galvanized steel unless otherwise indicated.
      a. Provide wiring gutters sized to accommodate the conductors to be installed.
   3. Fronts:
      a. Fronts for Surface-Mounted Enclosures: Same dimensions as boxes.
      b. Fronts for Flush-Mounted Enclosures: Overlap boxes on all sides to conceal rough opening.
   4. Lockable Doors: All locks keyed alike unless otherwise indicated.

I. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.

2.03 LIGHTING AND APPLIANCE PANELBOARDS

A. Description: Panelboards complying with NEMA PB 1, lighting and appliance branch circuit type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.

B. Conductor Terminations:
   1. Main and Neutral Lug Material: Copper suitable for terminating copper conductors only.
   2. Main and Neutral Lug Type: Mechanical.

C. Bussing:
   1. Phase Bus Connections: Arranged for sequential phasing of overcurrent protective devices.
   2. Phase and Neutral Bus Material: Copper.
   3. Ground Bus Material: Copper.

D. Circuit Breakers: Thermal magnetic bolt-on type unless otherwise indicated.

E. Enclosures:
   1. Provide surface-mounted or flush-mounted enclosures as indicated.
   2. Provide clear plastic circuit directory holder mounted on inside of door.

2.04 OVERCURRENT PROTECTIVE DEVICES

A. Molded Case Circuit Breakers:
   1. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
   2. Interrupting Capacity:
      a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:
         1) 10,000 rms symmetrical amperes at 240 VAC or 208 VAC.
         2) 14,000 rms symmetrical amperes at 480 VAC.
      b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
      c. Series Rated Systems: Provide circuit breakers listed in combination with upstream devices to provide interrupting rating not less than the short circuit current rating indicated.
   3. Conductor Terminations:
      a. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
   4. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
   5. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.

PART 3 EXECUTION

3.01 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).

B. Install products in accordance with manufacturer's instructions.

C. Install panelboards in accordance with NECA 407 and NEMA PB 1.1.

D. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

E. Provide required support and attachment in accordance with Section 26 05 29.

F. Install panelboards plumb.

G. Install flush-mounted panelboards so that trims fit completely flush to wall with no gaps and rough opening completely covered.

H. Mount panelboards such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches (2000 mm) above the floor or working platform.

I. Provide minimum of six spare 1 inch (27 mm) trade size conduits out of each flush-mounted panelboard stubbed into accessible space above ceiling and below floor.

J. Provide grounding and bonding in accordance with Section 26 05 26.

K. Install all field-installed branch devices, components, and accessories.

L. Provide filler plates to cover unused spaces in panelboards.

M. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads.

N. Provide engraved plastic nameplates under the provisions of Section 26 0553.

3.02 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

B. Adjust alignment of panelboard fronts.

C. Load Balancing: For each panelboard, rearrange circuits such that the difference between each measured steady state phase load does not exceed 20 percent and adjust circuit directories accordingly. Maintain proper phasing for multi-wire branch circuits.

END OF SECTION

SECTION 26 27 26
WIRING DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wall switches.

B. Receptacles.

C. Wall plates.

1.02 RELATED REQUIREMENTS

A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.

B. Section 26 05 33.16 - Boxes for Electrical Systems.

C. Section 26 05 33.16 - Boxes for Electrical Systems.

D. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

A. FS W-C-596 - Connector, Electrical, Power, General Specification for 2017h.

B. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush-mounted (General Specification) 2017g.

C. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.

D. NECA 130 - Standard for Installing and Maintaining Wiring Devices 2010.

E. NEMA WD 1 - General Color Requirements for Wiring Devices 1999 (Reaffirmed 2015).

F. NEMA WD 6 - Wiring Devices - Dimensional Specifications 2016.

G. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. UL 20 - General-Use Snap Switches Current Edition, Including All Revisions.

I. UL 498 - Attachment Plugs and Receptacles Current Edition, Including All Revisions.

J. UL 514D - Cover Plates for Flush-Mounted Wiring Devices Current Edition, Including All Revisions.

K. UL 943 - Ground-Fault Circuit-Interrupters Current Edition, Including All Revisions.

1.04 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Products: Listed, classified, and labeled as suitable for the purpose intended.

1.05 EXTRA MATERIALS

A. Furnish two of each style, size, and finish wall plate.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Hubbell Incorporated; www.hubbell-wiring.com.

B. Leviton Manufacturing Company, Inc; www.leviton.com.

C. Pass & Seymour, a brand of Legrand North America, Inc; www.legrand.us

D. Cooper Wiring Devices; www.cooperwiringdevices.com.

2.02 ALL WIRING DEVICES

A. Provide products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

B. Finishes:
   1. All Wiring Devices: White with brushed stainless steel wall plate unless otherwise indicated.
   2. Wiring Devices Installed in Wet or Damp Locations: White with specified weatherproof cover unless otherwise indicated.

2.03 WALL SWITCHES

A. Wall Switches - General Requirements: AC only, quiet operating, general-use snap switches with silver alloy contacts, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 20 and where applicable, FS W-S-896; types as indicated on the drawings.
   1. Wiring Provisions: Terminal screws for side wiring and screw actuated binding clamp for back wiring with separate ground terminal screw.

2.04 RECEPTACLES

A. Receptacles - General Requirements: Self-grounding, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 498, and where applicable, FS W-C-596; types as indicated on the drawings.
   1. Wiring Provisions: Terminal screws for side wiring or screw actuated binding clamp for back wiring with separate ground terminal screw.
   2. NEMA configurations specified are according to NEMA WD 6.

B. GFCI Receptacles:
   1. GFCI Receptacles - General Requirements: Self-testing, with feed-through protection and light to indicate ground fault tripped condition and loss of protection; listed as complying with UL 943, class A.
      a. Provide test and reset buttons of same color as device.
   2. Weather Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations.

2.05 WALL PLATES

A. Wall Plates: Comply with UL 514D.
   1. Configuration: One piece cover as required for quantity and types of corresponding wiring devices.
   2. Size: Standard.
   3. Screws: Metal with slotted heads finished to match wall plate finish.

B. Stainless Steel Wall Plates: Brushed satin finish, Type 302 stainless steel.

C. Weatherproof Covers for Damp Locations: Gasketed, cast aluminum, with self-closing hinged cover and corrosion-resistant screws; listed as suitable for use in wet locations with cover closed.

D. Weatherproof Covers for Wet Locations: Gasketed, cast aluminum, with hinged lockable cover and corrosion-resistant screws; listed as suitable for use in wet locations while in use with attachment plugs connected and identified as extra-duty type.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.

C. Verify that wall openings are neatly cut and will be completely covered by wall plates.

D. Verify that final surface finishes are complete, including painting.

E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

F. Verify that openings in access floor are in proper locations.

G. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.

B. Coordinate locations of outlet boxes provided under Section 26 05 33.16 as required for installation of wiring devices provided under this section.
   1. Mounting Heights: Unless otherwise indicated, as follows:
      a. Wall Switches: 48 inches (1200 mm) above finished floor.
      b. Receptacles: 18 inches (450 mm) above finished floor or 6 inches (150 mm) above counter.

C. Install wiring devices in accordance with manufacturer's instructions.

D. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.

E. Where required, connect wiring devices using pigtails not less than 6 inches (150 mm) long. Do not connect more than one conductor to wiring device terminals.

F. Connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal and tightening to proper torque specified by the manufacturer. Where present, do not use push-in pressure terminals that do not rely on screw-actuated binding.

G. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.

H. Install wiring devices plumb and level with mounting yoke held rigidly in place.

I. Install wall switches with OFF position down.

J. Install vertically mounted receptacles with grounding pole on top and horizontally mounted receptacles with grounding pole on left.

K. Install wall plates to fit completely flush to wall with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.

L. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.

3.04 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Perform field inspection, testing, and adjusting in accordance with Section 01 40 00.

C. Inspect each wiring device for damage and defects.

D. Operate each wall switch, wall dimmer, and fan speed controller with circuit energized to verify proper operation.

E. Test each receptacle to verify operation and proper polarity.

F. Test each GFCI receptacle for proper tripping operation according to manufacturer's instructions.

G. Correct wiring deficiencies and replace damaged or defective wiring devices.

3.05 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

3.06 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

END OF SECTION

SECTION 26 51 00
INTERIOR LIGHTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Interior luminaires.

B. Ballasts and drivers.

C. Accessories.

1.02 REFERENCE STANDARDS

A. IES LM-79 - Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products 2008.

B. IES LM-80 - Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays, and Modules 2015, with Errata (2017).

C. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.

D. NECA/IESNA 500 - Standard for Installing Indoor Commercial Lighting Systems 2006.

E. NECA/IESNA 502 - Standard for Installing Industrial Lighting Systems 2006.

F. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

G. NFPA 101 - Life Safety Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. UL 924 - Emergency Lighting and Power Equipment Current Edition, Including All Revisions.

I. UL 1598 - Luminaires Current Edition, Including All Revisions.

J. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products Current Edition, Including All Revisions.

1.03 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, installed accessories, and ceiling compatibility; include model number nomenclature clearly marked with all proposed features.
   1. LED Luminaires:
      a. Include estimated useful life, calculated based on IES LM-80 test data.

B. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

C. Operation and Maintenance Data: Instructions for each product including information on replacement parts.

1.04 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70 and NFPA 101.

PART 2 PRODUCTS

2.01 LUMINAIRE TYPES

A. Furnish products as indicated in luminaire schedule included on the drawings. For voluntary alternates, see Section 26 00 10.

2.02 LUMINAIRES

A. Provide products that are listed and labeled as complying with UL 1598, where applicable.

B. Provide products that comply with requirements of NFPA 70 and NFPA 101.

C. Provide products listed, classified, and labeled as suitable for the purpose intended.

D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.

E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc. as necessary for a complete operating system.

F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.

G. LED Luminaires:
   1. Components: UL 8750 recognized or listed as applicable.
   2. Tested in accordance with IES LM-79 and IES LM-80.
   3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.

H. Luminaires Mounted in Continuous Rows: Provide quantity of units required for length indicated, with all accessories required for joining and aligning.

2.03 BALLASTS AND DRIVERS

A. Ballasts/Drivers - General Requirements:
   1. Provide ballasts containing no polychlorinated biphenyls (PCBs).
   2. Minimum Efficiency/Efficacy: Provide ballasts complying with all current applicable federal and state ballast efficiency/efficacy standards.

PART 3 EXECUTION

3.01 INSTALLATION

A. Coordinate locations of outlet boxes provided under Section 26 05 33.16 as required for installation of luminaires provided under this section.

B. Install products in accordance with manufacturer's instructions.

C. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 500 (commercial lighting) and NECA 502 (industrial lighting).

D. Provide required support and attachment in accordance with Section 26 05 29.

E. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.

F. Suspended Ceiling Mounted Luminaires:
   1. Do not use ceiling tiles to bear weight of luminaires.
   2. Do not use ceiling support system to bear weight of luminaires unless ceiling support system is certified as suitable to do so.
   3. Secure surface-mounted and recessed luminaires to ceiling support channels or framing members or to building structure.
   4. Secure pendant-mounted luminaires to building structure.
   5. Secure lay-in luminaires to ceiling support channels using listed safety clips at four corners.
   6. See appropriate Division 9 section where suspended grid ceiling is specified for additional requirements.

G. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to center of luminaire.

H. Lighting in equipment rooms and electric closets is diagrammatic, indicating type, quantity, and general circuiting of fixtures. Modify locations and mounting to suit conditions, allowing clearances for equipment, piping and ductwork.

I. Install wall mounted luminaires, emergency lighting units, and exit signs at height as indicated on Drawings.

J. Install accessories furnished with each luminaire.

K. Bond products and metal accessories to branch circuit equipment grounding conductor.

L. Interface with air handling accessories.

M. Install lamps in each luminaire.

3.02 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Inspect each product for damage and defects.

C. Operate each luminaire after installation and connection to verify proper operation.

D. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Engineer.

E. New light fixtures SHALL NOT be used as temporary lighting. Once they are installed, test for proper installation, then leave off until ready to turn over to owner. Maintain temporary lighting throughout entire project.

3.03 ADJUSTING

A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Engineer. Secure locking fittings in place.

3.04 CLEANING

A. Clean surfaces according to NECA 500 (commercial lighting), NECA 502 (industrial lighting), and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.05 PROTECTION

A. Relamp luminaires that have failed lamps at Substantial Completion.

3.06 SCHEDULE - SEE DRAWINGS

END OF SECTION

SECTION 26 56 00
EXTERIOR LIGHTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Exterior luminaires.

1.02 REFERENCE STANDARDS

A. IES LM-79 - Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products 2008.

B. IES LM-80 - Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays, and Modules 2015, with Errata (2017).

C. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.

D. NECA/IESNA 501 - Standard for Installing Exterior Lighting Systems 2006.

E. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

F. UL 1598 - Luminaires Current Edition, Including All Revisions.

G. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products Current Edition, Including All Revisions.

1.03 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, weight, effective projected area (EPA), and installed accessories; include model number nomenclature clearly marked with all proposed features.
   1. LED Luminaires:
      a. Include estimated useful life, calculated based on IES LM-80 test data.

B. Operation and Maintenance Data: Instructions for each product including information on replacement parts.

1.04 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Electrical Components: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.01 LUMINAIRE TYPES

A. Furnish products as indicated in Schedule included on the Drawings. For voluntary alternates, see Section 26 00 10.

2.02 LUMINAIRES

A. Provide products that comply with requirements of NFPA 70.

B. Provide products that are listed and labeled as complying with UL 1598, where applicable.

C. Provide products listed, classified, and labeled as suitable for the purpose intended.

D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings, and other components required to position, energize and protect the lamp and distribute the light.

E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, poles, foundations, supports, trims, accessories, etc. as necessary for a complete operating system.

F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.

G. Provide luminaires listed and labeled as suitable for wet locations unless otherwise indicated.

H. LED Luminaires:
   1. Components: UL 8750 recognized or listed as applicable.
   2. Tested in accordance with IES LM-79 and IES LM-80.
   3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.

PART 3 EXECUTION

3.01 INSTALLATION

A. Coordinate locations of outlet boxes provided under Section 26 05 33.16 as required for installation of luminaires provided under this section.

B. Install products in accordance with manufacturer's instructions.

C. Install luminaires in accordance with NECA/IESNA 501.

D. Provide required support and attachment in accordance with Section 26 05 29.

E. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.

F. Install accessories furnished with each luminaire.

G. Bond products and metal accessories to branch circuit equipment grounding conductor.

H. Install lamps in each luminaire.

3.02 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Inspect each product for damage and defects.

C. Operate each luminaire after installation and connection to verify proper operation.

D. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Engineer.

3.03 ADJUSTING

A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Engineer. Secure locking fittings in place.

B. Aim and adjust luminaires to provide illumination levels and distribution indicated on Drawings.

3.04 CLEANING

A. Clean surfaces according to NECA/IESNA 501 and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.05 CLOSEOUT ACTIVITIES

3.06 SCHEDULE - SEE DRAWINGS

END OF SECTION

SECTION 28 31 10
GAS DETECTION SYSTEM

PART 1 GENERAL

1.01 GENERAL

A. Furnish and install a gas detection and alarm system in the headworks buildings as herein specified

1.02 SYSTEM DESCRIPTION

A. General:
   1. System shall consist of a multi-point instrument capable of continuous and simultaneous monitoring for detection of the following:
      a. Combustible gas
      b. Oxygen deficiency
      c. Hydrogen Sulfide
   2. The system shall include a master control cabinet that will accept up to four plug-in detection modules of any combination of above gases.

B. Alarms:
   1. The system shall include local visual alarms.
   2. The system shall be capable of activating remote alarm relays when any one of the alarm conditions occur.
   3. Each alarm shall have two adjustable alarm level relays and a system fault relay.
   4. Alarms shall be preset, and factory calibrated prior to shipment.

1.03 QUALITY ASSURANCE

A. Field:
   1. For installation of the work of this section, use only personnel completely trained and experienced in installation of the materials and equipment, and thoroughly familiar with the original design and approved Shop Drawings.

B. Manufacturer:
   1. All equipment called for under this section of the specifications shall be supplied by a single manufacturer. The equipment manufacturer shall, in addition to the Contractor, assume the responsibility for proper installation and functioning of the equipment.
   2. The manufacturer shall supply proof of five similar units in successful operation. This information shall be submitted along with shop drawings and shall include but not be limited to the following:
      a. Name and location of installation.
      b. Name of person in direct responsible charge for the equipment.
      c. Address and phone number of person in direct responsible charge.
      d. Month and year the equipment was placed in operation.
      e. Brief description of equipment.

1.04 SUBMITTALS

A. General:
   1. Make all submittals in accordance with Section 01300 - SUBMITTALS.

B. Shop drawings:
   1. Submit Shop Drawings showing dimensions and details of construction and installation.

C. O & M manuals:
   1. Submit operation and maintenance manuals for the equipment.

D. Guarantee:
   1. Submit written guarantee in accordance with the contract documents.

E. Manufacturer's literature:
   1. Submit manufacturer's literature describing the operation of the system.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. The gas detection and alarm system shall be the product of Drager, Polytrron 5200, or equal.

2.02 MASTER CONTROL CABINET

A. The master circuit board shall contain all the common circuitry required to power the individual detection modules and receive signals from the detectors to activate the alarms.

B. Isolated relays shall be provided with normally open and normally closed contacts for signalling Low and High Alarm, and Malfunction.

C. The cabinet shall include an exterior reading meter displaying any selected channel.

D. The cabinet door shall contain a reset button to acknowledge alarms and a meter selection switch accessible from outside the cabinet. The detector selection switch shall be accessible after opening the cabinet door.

E. The cabinet shall be contained in a wall mounted case meeting the NEMA 4x requirements.

F. Power source shall be 120/230 volt AC and 12/24 VDC standby power for uninterrupted operation.

2.03 CALIBRATION KIT

A. The manufacturer shall provide the necessary calibration kit for field testing following installation. The calibration kit shall include all special tools, gases, and devices necessary to test all of the detectors. Gases shall be supplied in quantities sufficient to perform at least twelve calibrations.

2.04 GAS DETECTION

A. Combustible detection:
   1. Principle: Catalytic Combustion.
   2. Range: 0-100% Lower Explosive Limit.
   3. Alarm Settings
      a. Warning Alarm: 10% LEL
      b. High Alarm: 50% LEL
   4. Warning alarm shall be capable of being manually acknowledged and silenced. High alarm shall not be resettable until high gas condition is cleared.

B. Oxygen detection:
   1. Principle: Electrochemical Cell.
   2. Range: 0-25% Oxygen.
   3. Alarm Settings:
      a. Low alarm: 19.5%
      b. High alarm: 23.5%
   4. Oxygen alarms shall be self-resetting, continuing to operate until alarm condition is corrected.

C. Hydrogen sulfide detection:
   1. Principle: Electrochemical cell.
   2. Range: 0-50 ppm.
   3. Alarm settings:
      a. warning alarm: 10 ppm
      b. high alarm: 40 ppm

PART 3 EXECUTION

3.01 INSTALLATION

A. Install equipment in strict accordance with the manufacturer's recommendations and Shop Drawings as approved by the Engineer.

3.02 FIELD TESTING

A. With the help of a representative of the manufacturer, the Contractor shall thoroughly field test the system prior to turning the system over to the Owner. Start up services shall include: training session for plant operator covering use, setting of alarm thresholds, calibration, and routine service and trouble shooting.

3.03 ELECTRICAL WORK

A. All electrical work shall be performed as indicated on the drawings and as specified in Division 26, Electrical, and elsewhere in this section.

END OF SECTION

SECTION 31 00 00

EARTHWORK

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
1. Excavating, shaping, and grading surface
2. Excavating and backfilling for pipe trenches
3. Placing fill and embankments
4. Salvaging and stockpiling select material
5. Disposal of surplus or unsuitable material
6. Other earthwork indicated on the plans for site modification or placement of structures.

B. Related Sections
01 20 00 PRICE AND PAYMENT PROCEDURE
31 23 19 DEWATERING
31 40 00 SHORING AND UNDERPINNING

1.02 QUALITY ASSURANCES

A. Materials:
1. All materials used as fill or sub-base shall be approved by the Engineer.
2. Determine gradation in accordance with ASTM C-136.
3. Determine percent loss by washing in accordance with ASTM C-117.

B. Compaction:
1. Determine maximum density using the Modified Proctor Method, ASTM D-1557.
2. Engineer may approve other field determinations of maximum density, such as Michigan Cone.
3. Field determination of in place density shall be by Nuclear Density Method, ASTM D-2922, or other approved method.

C. Except as modified by this Section, perform earthwork in accordance with Division 2, MDOT Standard Specifications.

1.03 SITE CONDITIONS

A. Soil Borings
1. Soil borings were not conducted at the site.

1.04 UNIT PRICES

All work under this Section shall be considered as incidental to construction, unless specifically indicated on the BID SCHEDULE and referred to in Section 01 20 00 - PRICE AND PAYMENT PROCEDURE.

1.05 REFERENCED STANDARDS

Unless otherwise specified, the work for this Section shall conform to the applicable portions of the following Standard Specifications:

ASTM - American Society for Testing and Materials
MDOT - Michigan Department of Transportation
OSHA - Occupational Health and Safety Association

PART 2 PRODUCTS

2.01 MATERIALS

A. General:
1. All fill material shall be approved by the Engineer prior to placement.
2. Fill material shall be free from clay, organic matter, roots, debris, and frozen soil.
3. Obtain fill material from on-site excavations, or from an approved borrow area.
4. Provide Testing Laboratory with access to material source.

B. Class II and III backfill:
Granular material meeting requirements of Section 902 of the MDOT Standard Specifications for construction.

C. Pipe Bedding:
Granular material meeting requirements of ASTM D2321

D. Topsoil:
Dark brown or black loam, clay loam, or sandy loam, of a fertile, humus soil origin.

PART 3 EXECUTION

3.01 DUST CONTROL

A. Control dust at the Work area at all times to prevent dust from becoming a nuisance to the public, neighbors, or the work of others on the site.

B. Provide moisture or otherwise treat surfaces to control dust.

3.02 TOPSOIL

A. Removal:
1. Remove all topsoil from areas to be occupied by structures, improved surfaces, or where new grades are to be established.
2. Stockpile topsoil for future use in finish grading at a site approved by the Engineer.

B. Application:
1. Provide topsoil over all disturbed areas not occupied by structures or improved surfaces.
2. Spread the stockpiled topsoil over the prepared rough grade to a minimum depth of 4 inches.
3. Provide additional topsoil as required to complete the Work.
4. Finish grade, and rake the topsoil to remove all stones, sticks, roots, and debris in preparation for seeding.
5. Excess topsoil may be used for fill in non critical areas.

3.03 EXCAVATING-GENERAL

A. Excavate to the lines and grades shown on the plans.

B. Provide safe excavation slopes in accordance with OSHA Regulation 54 FR 45894.

C. Protect excavation bottoms from frost.

D. Dispose of excess excavated material off site or on site at a location approved by the Engineer.

E. Provide dewatering in accordance with the section stated in 1.01 (B) of this specification.

F. Enlarge excavations laterally to provide adequate room for construction or provide shoring and bracing in accordance with the section stated in 1.01 (B) of this specification, as necessary.

3.04 EXCAVATING, BACKFILLING, AND COMPACTING FOR STRUCTURES

A. Over-excavation:
1. In the event clay or stone is encountered at the bottom of the excavation, undercut bottom a minimum of 12 inches.
2. If muck or other deleterious material is encountered, remove this material to a depth where suitable subgrade soil is encountered, unless otherwise instructed by the Engineer.
3. Backfill to proposed subgrade elevation with Class II material.
4. Compact backfill in lifts not exceeding 9 inches to 95% Modified Proctor density.

B. Backfilling:
1. Remove all debris from excavation prior to backfilling.
2. Compact excavation bottom to 95 % Modified Proctor density to a depth of 2 feet prior to placing backfill.
3. Backfill material shall be Class II sand.
4. Do not backfill against cast in place structures until approved by the Engineer.
5. Do not backfill on only one side of a vertical wall unless the walls are adequately shored or the permanent structure is in place.
6. Compact backfill in lifts not exceeding 6 inches to 95% Modified Proctor density.
7. A sheepsfoot roller or other appropriate compaction equipment shall be used for the cohesive soils, provided it is approved by the Engineer and produces the specified results. A vibratory roller shall be used for granular soils.

3.05 EXCAVATING, BACKFILLING, AND COMPACTING FOR ROAD SUBGRADE, PAVED SURFACES AND APPURTENANCES

A. Subgrade undercutting:
1. Remove all peat, muck, topsoil and other organic matter from the roadway subgrade.
2. Remove all soils other than granular materials within 15 inches of the proposed subgrade elevation.
3. Place Class II sand and compact to 95% Modified Proctor density to proposed subgrade elevation.
4. Extend undercutting of unsuitable materials to the limit of a 1 on 1 slope spreading outward from the grade and location of the outside edge of the finished pavement, curb, or other improved surface.

B. Backfilling around curbs, sidewalks, and appurtenances:
1. Remove all debris from excavation prior to backfilling.
2. Compact excavation bottom to 95 % Modified Proctor density to a depth of 2 feet prior to placing backfill.
3. Backfill material shall be Class II sand.
4. Do not backfill against cast in place structures until approved by the Engineer.
5. Compact backfill in lifts not exceeding 6 inches to 95% Modified Proctor density.
6. A sheepsfoot roller or other appropriate compaction equipment shall be used for the cohesive soils, provided it is approved by the Engineer and produces the specified results. A vibratory roller shall be used for granular soils.

3.06 EXCAVATING, BACKFILLING, AND COMPACTING FOR UTILITIES

A. Trench excavation:
   1. Conduct excavation in a safe and orderly manner at all times, in compliance with all applicable safety regulations.
   2. Use hand tools where mechanical equipment will cause damage to adjacent trees, structures, or utilities.
   3. Excavate trench to the cross-section shown on the trench detail.
   4. Trenches and backfill shall comply with AWWA C605.
   5. Do not excavate the trench ahead of the pipe laying operation more than the Contractor can reasonably expect to backfill by the end of the work day.
   6. Support and protect all existing utilities encountered within the trench.
   7. Place excavated material where it will not obstruct sidewalks, driveways, roadways, or the work of others.
   8. Undercutting
      a. In the event clay or stone is encountered at the bottom of the excavation, undercut the bottom a minimum of 6 inches.
      b. Undercut the trench a minimum of 6 inches for plastic water main or sanitary sewers in all soils.
      c. If muck or other deleterious material is encountered, remove this material to suitable soil, unless modified by the Engineer.
      d. Backfill to proposed pipe grade with material meeting ASTM D2321 compacted to 95% Modified Proctor density.

B. Pipe bedding:
   1. Grade trench bottom to provide uniform, firm, and stable surface, free from rocks and other unsuitable materials.
   2. Provide a tamped sand bedding for the full length of the pipe barrel, with recesses excavated for the joints.
   3. Bedding material shall meet requirements of ASTM D2321.
   4. Place bedding simultaneously on each side of the pipe for the full width of the trench, to a depth of 1 foot above the pipe.
   5. Place bedding in 9 inch layers and compact to 95% Modified Proctor Density, being careful not to displace the pipe laterally.

C. Trench backfill, critical areas:
   1. Class II material in areas under or within 10 feet of structures or improved surfaces.
   2. Place in layers not exceeding 9 inches and compact each layer, by mechanical means, to 95% Modified Proctor density.
   3. If trench settles greater than 1 inch within the one year following Owner's acceptance of project, the Contractor shall bring the trench back to grade and restore the surface at no additional cost to the Owner.

D. Trench backfill, non-critical areas:
   1. Class III material approved by the Engineer, free from frozen soil, vegetation, and debris.
   2. Place in layers not exceeding 12 inches and compact each layer by mechanical means to a minimum of 90% Modified Proctor density.

E. Pipe protection:
   1. Mound and compact additional granular backfill over pipe, if required, to provide a minimum cover depth of 3 feet to protect pipe while construction equipment is operating on site.
   2. Remove additional backfill when grading to achieve finished grade.

3.07 CONTROLLED FILLS AND EMBANKMENTS

A. General:

1. All filling under or within a 1:1 slope from the outer edge of buildings, structures, or improved surfaces shall be controlled fill.
2. Material: Class II granular material, unless otherwise specified by the Engineer.

B. Placing fill:
1. Remove topsoil roots and stumps to a depth of 12 inches prior to prior to placing fill.
2. Compact existing ground to 95% Modified Proctor density prior to placing fill.3. Spread fill in uniform layers not exceeding 9 inches and compact to 95% Modified Proctor density.

C. Compaction:
1. Compacting equipment shall be heavy duty, rolling drum, vibrating type.
2. Use pneumatic tire rollers in predominantly granular soils.
3. Use sheepsfoot type roller in predominantly clay soils.
4. Use hand operated vibrating sled for compaction around structures.
5. Other methods of producing equivalent results will be allowed when approved by the Engineer.
6. Density in areas under or adjacent to structures or improved surfaces shall be to 95% Modified Proctor density.
7. Density in other locations shall be to 90% Modified Proctor density.

D. Moisture:
If material is too wet or dry for satisfactory compaction, adjust moisture content as required.

3.08 GRADING

A. Conform to lines, contours, and spot elevations shown on the plans.

B. Perform finish grading on ground surfaces to an accuracy of plus or minus 0.1 feet.

C. Perform finish grading on improved surfaces to an accuracy of plus or minus 0.05 feet.

END OF SECTION

SECTION 31 10 00

SITE CLEARING AND PREPARATION

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Clearing site of trees, roots, stumps, brush, and other vegetation.
   2. Removing rocks, boulders, and other debris.

B. Related Sections:
   Section 01 20 00 - PRICE AND PAYMENT PROCEDURE

1.02 UNIT PRICES

All work under this section shall be considered incidental to construction, unless specifically indicated on the BID SCHEDULE and referred to in Section 01 20 00 - PRICE AND PAYMENT PROCEDURE.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.01 SITE CLEARING

A. General:
   1. Clear areas as necessary to perform the work.
   2. Remove trees, stumps, roots, brush, and rocks.
   3. Work carefully around trees and aboveground utilities.
   4. Trees and branches shall not be removed without permission of owner.

3.02 REMOVAL OF EXISTING IMPROVEMENTS

Section Not Used

3.03 DISPOSAL OF MATERIALS

A. All concrete, trees (as approved), asphalt, gravel, etc. resulting from removal shall become the property of the Contractor. Stumps may be piled onsite with permission from the Owner.

B. All removed materials shall be removed from the project site and disposed of properly.

C. Burning is not permitted without permission from the owner.

END OF SECTION

SECTION 31 12 00

SELECTIVE CLEARING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Provide all the labor, tools and equipment necessary for the removal, demolition, and disposal of the following items:
   1. Existing yard piping as indicated on plans
   2. Existing pavement as indicated on plans
   3. Existing septic tanks as indicated on plans

B. Salvage the following items as specified or if so directed by the Owner:
   1. Existing lift station pumps.

C. Related Sections
   Section 01 20 00 - PRICE AND PAYMENT PROCEDURE

1.04 UNIT PRICES

Refer to Section 01 20 00 - PRICE AND PAYMENT PROCEDURE.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.01 GENERAL

A. Coordinate the work in this section with the Owner. The demolition work must be staged to meet the Contractor's construction schedule and the requirements that the Owner must continue to operate the wastewater treatment facility throughout the construction activities.

B. Demolition of an item requires proper onsite storage, proper transportation on and off site and proper disposal in a legal manner off site, at the Contractor's expense.

C. Salvage of an item means that the Contractor shall make a normal effort to remove the item in usable condition and stockpile the item for removal by the Owner. The Contractor shall be responsible for moving all salvage items to an area accessible by a stake truck, and loading the items on the truck. The Owner will furnish the truck and the driver within 2 working days of when requested.

D. Items to be salvaged for re-use are currently working properly and must work in a similar fashion, if the item is to be re-used in another location. If after the item is removed and moved to the next location and does not work as it did prior to being removed, the contractor will be responsible for getting the equipment operational at his own expense and at the satisfactory approval of the Engineer. If the salvaged/moved equipment cannot be fixed and put into satisfactory operation, the contractor shall replace the equipment with new at the approval of the Engineer.

3.02 DEMOLITION

A. Concrete structures and Septic Tanks:
   1. Remove all debris, sludge, material, etc. prior to abandonment or filling.
   2. Remove or crush existing tank in place.
   3. Where piping protrudes into existing structures, remove valves, caps, etc., if installed; plug/fill pipe with minimum two- (2) feet of concrete before filling structure (or as noted on plans Make all cuts in straight lines.
   4. Restore site in accordance with specifications.

B. Pipes:
   1. Saw cut existing pipes where indicated.
   2. Bevel saw cut pipe end as required to provide end satisfactory for joint with new pipe.
   3. Plug and abandon corrugated metal pipe (CMP) in place as indicated on Site Demolition Plans.
   4. Where piping protrudes into existing structures, remove valves, caps, etc., if installed; plug/fill pipe with minimum two- (2) feet of concrete before filling structure (or as noted on plans).

C. Manholes:
   1. Remove manholes in conflict with construction. Salvage castings for the Owner.
   2. Decapitate influent diversion manhole to 2’ below grade. Fill structure and pipe with flowable fill per 3.02 (B). of this specification.

D. Valves:
   1. Salvage valves and valve boxes which are in good condition for the Owner.

E. Miscellaneous:
   1. Stockpile excess fill and riprap in location designated by Engineer.

END OF SECTION

SECTION 31 23 19

DEWATERING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes providing and maintaining dewatering equipment to dispose of surface water and ground water from all excavations and trenches.

B. Related Sections:
Section 01 20 00 - PRICE AND PAYMENT PROCEDURE

1.02 UNIT PRICES

Dewatering will be considered incidental to the construction, unless specifically indicated on the BID SCHEDULE and referred to in Section 01 20 00 - PRICE AND PAYMENT PROCEDURE.

1.03 SUBMITTALS

A. Submit a description of the proposed system to the Engineer prior to installation.

B. Description shall include the number, size, and length of wells, pumping equipment, temporary underdrain location, discharge location, and sedimentation control measures.

1.04 QUALITY ASSURANCE

A. Design of the dewatering method shall be the responsibility of the Contractor.

B. Comply with the Soil Erosion and Sedimentation Control Act, and other state and local codes that govern dewatering activities.

C. Design over 70 gpm and/or 2 MGD will require additional EGLE review for approval.

1.05 DESIGN REQUIREMENTS

A, Dewatering system shall be capable of lowering the static water table a minimum of 12 inches below all excavations.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.01 PERFORMANCE REQUIREMENTS

A. Duration of dewatering:
1. Continuously until the structure or pipe is installed.
2. Prevent damage from hydrostatic pressure, flotation, or other causes.

B. Reliability:
1. Monitor the dewatering system at frequent intervals to insure proper operation.
2. Provide stand-by equipment as necessary to avoid equipment or power failure.

C. Discharge:
1. Prevent sand and silt from discharging into sewer drains or natural waterways.
2. Provide silt fencing, sediment traps, or other methods to protect surface water discharges.

3. Remove all sediment deposits created as a result of the dewatering process.
4. Do not interfere with the rights of the public, owners of private property, pedestrians, vehicular traffic, or the work of other Contractors.

D. Surface water runoff:
1. Divert surface water from entering excavated areas or trenches.
2. Protect adjacent property from damage.
3. Repair any damage from dewatering activities at no additional cost to the Owner.

E. Remove all dewatering wells and equipment after project completion.

END OF SECTION

SECTION 31 25 00

EROSION AND SEDIMENTATION CONTROL

PART 1 GENERAL

1.01 SUMMARY

A. Section includes, work necessary for effective temporary and permanent soil erosion and sedimentation control.

B. Related Sections:
1. Section 01 20 00 - PRICE AND PAYMENT PROCEDURE
2. Section 31 00 00 - EARTHWORK
3. Section 32 90 00 - PLANTING

1.02 UNIT PRICES

Temporary and permanent erosion control measures will be considered incidental to the construction, unless specifically indicated on the BID SCHEDULE and referred to in Section 01025 MEASUREMENT AND PAYMENT.

1.03 QUALITY ASSURANCES

Perform all Work in accordance with the Michigan Soil Erosion and Sedimentation Control Act, Part 91 of Act 451, P.A. 1994, and with the requirements of the local agencies having jurisdiction over the Work.

PART 2 PRODUCTS

2.01 MATERIALS

A. Seed, fertilizer, and mulch: Provide as specified in Section 32 90 00 - PLANTING.

B. Provide temporary and permanent structures and materials in accordance with the Michigan Department of management and Budget Keying System. See Figure 1 at the end of this section.

C. Mulch blanket:
1. Materials: 100% straw sewn into a lightweight, photo degradable netting.
2. In compliance with MDOT specification 917.15B.2.b.
3. Manufacturer and Model:
a. North American Green S75.
b. Contech SFB1
c. Verdyol Eromat V75S(S.D.)
d. Or equal product
4. Straw content: Minimum 0.5 pounds per square yard.

D. Geotextile filter fabric:
1. Materials: Mechanically bonded, non-woven geotextile.
2. Manufacturer and Model:
a. Amoco CEF 4553
b. Contech C-100NW

c. SI Geosynthetics 801
d. Mirafi 180N
e. Or equal product

3. Tensile strength: 203 lbs. (ASTM D-4632).
4. Tensile elongation: 50% min. (ASTM D-4632).
5. Tear strength: 80 lbs. (ASTM D-4533).
6. Puncture strength: 130 lbs. (ASTM D-4833).
7. Apparent opening size: 100 sieve (ASTM D-4751).

E. Rip rap stone: (4-6")
1. Material: native fieldstone from local gravel pits, exhibiting sound structure and strength for the intended use.
2. Size: 1" to 6" stone.
3. Gradation:
a. D_{100} = 6 inch
b. D_{50} = 4 inch
c. D_{10} = 2 inch

F. Rip rap stone: (10-12")
1. Material: native fieldstone from local gravel pits, exhibiting sound structure and strength for the intended use.
2. Size: 6" to 12" stone.
3. Gradation:
a. D_{100} = 12 inch
b. D_{50} = 10 inch
c. D_{10} = 8 inch

G. Silt fence:
1. Conforming to Michigan Department of Transportation Standard Specifications.

H. Filter Bag:
1. Material: nonwoven, needlepunched, polypropylene geotextile
2. Size: 15’ x 10’ minimum
3. Manufacturer: CSI Geoturf

PART 3 EXECUTION

3.01 GENERAL

Conduct site evaluation with the Engineer and the soil erosion control officer prior to starting work.

3.02 TEMPORARY EROSION CONTROL

A. Minimize the area of earth disturbed at any one time.

B. Provide berms or ditches to divert storm runoff from the construction area when steep slopes or highly erodible soils are present.

C. Contain all sedimentation on site by using straw bales, filter fence, or sedimentation basins.

3.03 PERMANENT EROSION CONTROL

A. When final grades have been established, provide topsoil, seed, fertilizer, and mulch.

B. Water all seeded areas as necessary to establish proper vegetative cover.

C. Should erosion occur within the guarantee period, regrade and reseed the disturbed area at no additional cost to the Owner.

3.04 MULCH BLANKET

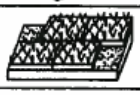
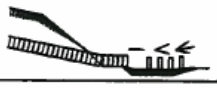
A. Provide mulch blanket on all slopes 3:1 or steeper, that are disturbed during construction or as indicated on the plans.
B. Prepare soil prior to placing mulch blanket with topsoil, seed and fertilizer.

C. Place mulch blanket from top of slope down so overlap seams run parallel to slope.

D. Overlap seams a minimum of 2" on parallel seams, and six inches, shingle style, on perpendicular splices.

MICHIGAN DEPARTMENT OF MANAGEMENT AND BUDGET

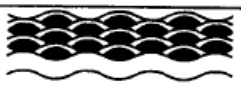
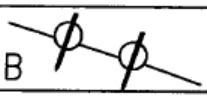
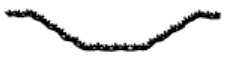
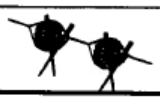
S–E–S–C KEYING SYSTEM

KEY	BEST MANAGEMENT PRACTICES	SYMBOL	WHERE USED
EROSION CONTROLS			
E1	SELECTIVE GRADING AND SHAPING		To reduce steep slopes and erosive velocities.
E2	GRUBBING OMITTED		For use on steep slopes to prevent rilling, gullying, and reduce sheet flow velocity or where clear vision corridors are necessary.
E3	SLOPE ROUGHENING AND SCARIFICATION		Where created grades cause increased erosive velocites. Promotes infiltration and reduces runoff velocity.
E4	TERRACES		On relatively long slopes up to 8% grades with fairly stable soils.
E5	DUST CONTROL		For use on construction sites, unpaved roads, etc. to reduce dust and sedimentation from wind and construction activities.
E6	MULCH		For use in areas subject to erosive surface flows or severe wind or on newly seeded areas.
E7	TEMPORARY SEEDING		Stabilization method utilized on construction sites where earth change has been initiated but not completed within a 2 week period.
E8	PERMANENT SEEDING		Stabilization method utilized on sites where earth change has been completed (final grading attained).
E9	MULCH BLANKETS		On exposed slopes, newly seeded areas, new ditch bottoms, or areas subject to erosion.
E10	SODDING		On areas and slopes where immediate stabilization is required.
E11	VEGETATED CHANNELS		For use in created stormwater channels. Vegetation is used to slow water velocity and reduce erosion within the channel.
E12	RIPRAP		Use along shorelines, waterways, or where concentrated flows occur. Slows velocity, reduces sediment load, and reduces erosion.
E13	GABION WALLS		On newly created or denuded stream banks to reduce velocity until permanent stabilization is achieved or on existing banks to retard erosive velocities.
E14	ENERGY DISSIPATOR		Where the energy transmitted from a concentrated flow of surface runoff is sufficient to erode receiving area or watercourse.
E15	TEMPORARY SLOPE DRAIN		Where surface runoff temporarily accumulates or sheet flows over the top of a slope and must be conveyed down a slope in order to prevent erosion.
E16	SLOPE DRAIN		Where concentrated flow of surface runoff must be permanently conveyed down a slope in order to prevent erosion.

B = BIOENGINEERING

MICHIGAN DEPARTMENT OF MANAGEMENT AND BUDGET

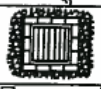
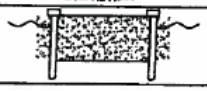
S-E-S-C KEYING SYSTEM

KEY	BEST MANAGEMENT PRACTICES	SYMBOL	WHERE USED
E17	CELLULAR CONFINEMENT SYSTEMS		Used on steep slopes and high velocity channels.
E18	PLASTIC SHEETS		Used on exposed slopes, seeded areas, new ditch bottoms, and areas subject to surface runoff and erosion. Used as a liner in temporary channels and to stabilize stockpiles.
E19	TEMPORARY DRAINAGEWAY/ STREAM CROSSING		Use on construction sites where stream/drainageway crossings are required.
E20	TEMPORARY BYPASS CHANNEL		Use within existing stream corridars when existing flow cannot be interrupted, and at culvert and bridge repair sites
E21	LIVE STAKING	 B	In areas requiring protection of slopes against surface erosion and shallow mass wasting.
	EROSION / SEDIMENT CONTROLS		
ES31	CHECK DAM		Used to reduce surface flow velocities within constructed and existing flow corridors.
ES32	STONE FILTER BERM		Use primarily in areas where sheet or rill flow occurs and to accommodate dewatering flow.
ES33	FILTER ROLLS	 B	In areas requiring immediate protection of slopes against surface erosion and gully formation and for perimeter sediment control.
ES34	SAND FENCE		For use in areas susceptible to wind erosion, especially where the ground has not yet been stabilized by other means.
ES35	DEWATERING		Use where construction activities are limited by the presence of water and dry work is required.
ES36	DIVERSION DIKE/BERM		Within existing flow corridors to address or prevent erosion and sedimentation, or on disturbed or unstable slopes subject to erosive surface water velocities.
ES37	DIVERSION DITCH		In conjunction with a diversion dike, or where diversion of upslope runoff is necessary to prevent damage to unstabilized or disturbed construction areas.
ES38	COFFERDAM/SHEET PILINGS		Constructed along or within water corridor or waterbody to provide dry construction area.
ES39	STREAMBANK BIOSTABILIZATION	 B	For use along banks where stream and riparian zones may have difficulty recovering from the long-term effects of erosion.
ES40	POLYMERS		To minimize soil erosion and reduce sedimentation in water bodies by increasing soil particle size.
ES41	WATTLES	 B	In areas requiring protection of slopes against surface erosion and gully formation.

B = BIOENGINEERING

MICHIGAN DEPARTMENT OF MANAGEMENT AND BUDGET

S-E-S-C KEYING SYSTEM

KEY	BEST MANAGEMENT PRACTICES	SYMBOL	WHERE USED
	SEDIMENT CONTROLS		
S51	SILT FENCE		Use adjacent to critical areas, to prevent sediment laden sheet flow from entering these areas.
S52	CATCH BASIN SEDIMENT GUARD		Use in or at stormwater inlets, especially at construction sites.
S53	STABILIZED CONSTRUCTION ACCESS		Used at every point where construction traffic enters or leaves a construction site.
S54	TIRE WASH		For use on construction sites where vehicular traffic requires sediment removed from its tires in highly erosive areas.
S55	SEDIMENT BASIN		At the outlet of disturbed areas and at the location of a permanent detention basin.
S56	SEDIMENT TRAP		In small drainage areas, along construction site perimeters, and above check dams or drain inlets.
S57	VEGETATED BUFFER/FILTER STRIP		Use along shorelines, waterways, or other sensitive areas. Slows velocity, reduces sediment load, and reduces erosion in areas of sheet flow.
S58	INLET PROTECTION FABRIC DROP		Use at stormwater inlets, especially at construction sites.
S59	INLET PROTECTION FABRIC FENCE		Use at stormwater inlets, especially at construction sites.
S60	INLET PROTECTION STONE		Use around urban stormwater inlets.
S61	TURBIDITY CURTAIN		Use during construction adjacent to a water source, to contain sediment within the work area when other BMP's cannot be used.

B = BIOENGINEERING

END OF SECTION

SECTION 31 40 00

SHORING AND UNDERPINNING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish, install, and maintain sheeting, shoring, bracing, and trench boxes as required to support the sides of the excavation.

B. Prevent movement of earth that would damage the Work or existing structures, or cause injury to workmen.

1.02 RELATED SECTIONS

Section 01 20 00 - PRICE AND PAYMENT PROCEDURE

1.03 UNIT PRICES

Sheeting, shoring and bracing will be considered incidental to the performance of the work, unless specifically indicated on the BID SCHEDULE and referred to in Section 01025 MEASUREMENT AND PAYMENT.

1.04 QUALITY ASSURANCES

Comply with all standards set forth in the Federal and State Occupational Safety and Health Act.

PART 2 PRODUCTS - Not used.

PART 3 EXECUTION

3.01 INSTALLATION

A. Provide sheeting, shoring, trench box, or bracing to prevent caving or sliding, and to protect workmen and adjacent structures and facilities.

B. Fill and compact voids outside the sheeting.

C. Prevent concentrated loads on any structure or pipe within the excavation.

3.02 REMOVAL

A. Remove sheeting without damage to the installed structure or pipe, and adjacent utilities or structures.

B. Fill all voids caused by withdrawal of sheeting with clean compacted sand.

3.03 SHEETING LEFT IN PLACE

Sheeting may be left in place with the permission of the Owner.

END OF SECTION

SECTION 32 15 00

AGGREGATE SURFACING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes all labor, materials, tools, and equipment necessary for the complete installation of aggregate surfaces, including roadways, driveways, and parking areas. Also includes providing, shaping and grading the sand base.

B. Related sections:
   1. Section 01 20 00 - PRICE AND PAYMENT PROCEDURE
   2. Section 01 45 29 - TESTING AND LABORATORY SERVICES

1.02 UNIT PRICES

Refer to Section 01 20 00 - PRICE AND PAYMENT PROCEDURE

1.03 QUALITY ASSURANCES

A. Testing:
   1. Test in accordance with Section 01 45 29 - TESTING AND LABORATORY SERVICES.
   2. All materials used as fill or sub-base shall be approved by the Engineer.
   3. Determine gradation in accordance with ASTM D-136.
   4. Determine percent loss by washing in accordance with ASTM D-117.

B. Compaction:
   1. Determine maximum density using the Modified Proctor Method, ASTM D-1557 Engineer may approve other field determinations of maximum density, such as Michigan Cone.
   2. Field determination of in place density shall be by Nuclear Density Method, ASTM D-2922, or other approved method.

PART 2 PRODUCTS

2.01 MATERIALS

Aggregate Surface Material: MDOT 22A

PART 3 EXECUTION

3.01 AGGREGATE SURFACES

A. Place a minimum depth of 6 inches compacted in place.

B. Compact to 98% maximum density.

C. Adjust moisture content as required to achieve compaction.

D. Grading:
   1. Finish surface grade to conform to the elevations and cross sections shown on the Plans.
   2. Contractor is responsible for verifying proper finish grades.

END OF SECTION

SECTION 32 32 15
PRECAST MODULAR BLOCK GRAVITY RETAINING WALL

PART 1 – GENERAL

1.01 SUMMARY

A. This Section includes furnishing all materials and labor required for the design and construction of a precast concrete modular block (PMB) gravity retaining wall without geosynthetic reinforcement. Precast modular block retaining wall blocks under this section shall be cast utilizing a wet-cast concrete mixture, exhibit a final handling weight in excess of 1,000 pounds (450 kg) per unit, and may utilize concrete reinforcing steel.

B. Scope of Work: The work shall consist of furnishing materials, labor, equipment, and supervision for the construction of a precast modular block (PMB) retaining wall structure in accordance with the requirements of this section and in acceptable conformity with the lines, grades, design, and dimensions shown in the project site plans.

C. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 31, Division 32 and Division 33 also apply to this Section.

1.02 PRICE AND PAYMENT PROCEDURES

A. Allowances. No allowance shall be made in the price of the retaining wall for excavation beyond the limits required for retaining wall construction as shown on the project plans. The cost of excavation for the purposes of site access shall be the responsibility of the General Contractor. Removal of unsuitable soils and replacement with select fill shall be as directed and approved in writing by the Owner or Owner's representative and shall be paid under separate pay items.

B. Unit Prices. In addition to a lump sum price pursuant to completion of the scope of work described in Part 1.01 of this Section, the General Contractor shall provide a unit price per square foot of vertical wall face that shall be the basis of compensation for up to a ten (10) percent increase or reduction in the overall scope of the retaining wall work.

C. Measurement and Payment.
   1. The unit of measurement for furnishing the precast modular block retaining wall system shall be the vertical area of the wall face surface as measured from the top of the leveling pad to the top of the wall including coping. The final measured quantity shall include supply of all material components and the installation of the precast modular block retaining wall system.
   2. The final accepted quantities of the precast modular block retaining wall system will be compensated per the vertical face area as described above. The quantities of the precast modular block retaining wall as shown on the plans and as approved by the Owner shall be the basis for determination of the final payment quantity. Payment shall be made per square foot of vertical wall face.

1.03 REFERENCES

A. Where the specification and reference documents conflict, the Owner's designated representative will make the final determination of the applicable document.

B. Definitions:
   1. Precast Modular Block (PMB) Unit – machine placed, "wet cast" concrete modular block retaining wall facing unit.
   2. Geotextile – a geosynthetic fabric manufactured for use as a separation and filtration medium between dissimilar soil materials.
   3. Drainage Aggregate – clean, crushed stone placed within and immediately behind the precast modular block units to facilitate drainage and reduce compaction requirements immediately adjacent to and behind the precast modular block units.
   4. Unit Core Fill – clean, crushed stone placed within the hollow vertical core of a precast modular block unit. Typically, the same material used for drainage aggregate as defined above.
   5. Foundation Zone – soil zone immediately beneath the leveling pad.
   6. Retained Zone – soil zone immediately behind the drainage aggregate and wall infill for wall sections designed as modular gravity structures.
   7. Leveling Pad – hard, flat surface upon which the bottom course of precast modular blocks are placed. The leveling pad may be constructed with crushed stone or cast-in-place concrete. A leveling pad is not a structural footing.
   8. Wall Infill – the fill material placed and compacted between the drainage aggregate and the excavated soil face in retaining wall sections designed as modular gravity structures.

C. Reference Standards
   1. Design
      a. AASHTO LRFD Bridge Design Specifications, 8th and 9th Edition.
      b. Minimum Design Loads for Buildings and Other Structures – ASCE/SEI 7-16.
      c. International Building Code, 2018 Edition.
      d. Design Manual for Segmental Retaining Walls, National Concrete Masonry Association, 3rd Edition, 2010.
   2. Precast Modular Block Units
      a. ACI 201 – Guide to Durable Concrete
      b. ACI 318 – Building Code Requirements for Structural Concrete
      c. ASTM C33 – Standard Specification for Concrete Aggregates
      d. ASTM C39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
      e. ASTM C94 – Standard Specification for Ready-Mixed Concrete.
      f. ASTM C136 – Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
      g. ASTM C143 – Standard Test Method for Slump of Hydraulic-Cement Concrete.
      h. ASTM C150 – Standard Specification for Portland Cement
      i. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
      j. ASTM C260 – Standard Specification for Air-Entraining Admixtures for Concrete.
      k. ASTM C494 – Standard Specification for Chemical Admixtures for Concrete.
      l. ASTM C595 - Standard Specification for Blended Hydraulic Cements.
      m. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.

n. ASTM C666 – Standard Test Method for Concrete Resistance to Rapid Freezing and Thawing.
o. ASTM C845 - Standard Specification for Expansive Hydraulic Cement.
p. ASTM C920 – Standard Specification for Elastomeric Joint Sealants.
q. ASTM C989 - Standard Specification for Slag Cement for Use in Concrete and Mortars.
r. ASTM C1116 – Standard Specification for Fiber-Reinforced Concrete.
s. ASTM C1157 - Standard Performance Specification for Hydraulic Cement.
t. ASTM C1218 - Standard Test Method for Water-Soluble Chloride in Mortar and Concrete.
u. ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures.
v. ASTM C1611 – Standard Test Method for Slump Flow of Self-Consolidating Concrete.
w. ASTM C1776 – Standard Specification for Wet-Cast Precast Modular Retaining Wall Units.
x. ASTM D6638 – Standard Test Method for Determining Connection Strength Between Geosynthetic Reinforcement and Segmental Concrete Units (Modular Concrete Blocks).
y. ASTM D6916 – Standard Test Method for Determining Shear Strength Between Segmental Concrete Units (Modular Concrete Blocks).

3. Geosynthetics
   a. AASHTO M 288 – Geotextile Specification for Highway Applications.
   b. ASTM D3786 – Standard Test Method for Bursting Strength of Textile Fabrics Diaphragm Bursting Strength Tester Method.
   c. ASTM D4354 – Standard Practice for Sampling of Geosynthetics for Testing.
   d. ASTM D4355 – Standard Test Method for Deterioration of Geotextiles
   e. ASTM D4491 – Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
   f. ASTM D4533 – Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
   g. ASTM D4595 – Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method.
   h. ASTM D4632 – Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
   i. ASTM D4751 – Standard Test Method for Determining Apparent Opening Size of a Geotextile.
   j. ASTM D4759 – Standard Practice for Determining Specification Conformance of Geosynthetics.
   k. ASTM D4833 – Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products.
   l. ASTM D4873 – Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples.
   m. ASTM D6241 – Standard Test Method for the Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe.

4. Soils
   a. AASHTO M 145 – AASHTO Soil Classification System.
   b. AASHTO T 104 – Standard Method of Test for Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate.
   c. AASHTO T 267 – Standard Method of Test for Determination of Organic Content in Soils by Loss of Ignition.
   d. ASTM C33 – Standard Specification for Concrete Aggregates.
   e. ASTM D448 – Standard Classification for Sizes of Aggregates for Road and Bridge Construction.

f. ASTM D698 – Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort. (12,400 ft-lbf/ft (2,700 kN-m/m)).
g. ASTM D1241 – Standard Specification for Materials for Soil-Aggregate Subbase, Base and Surface Courses.
h. ASTM D1556 – Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method.
i. ASTM D1557 – Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort. (56,000 ft-lbf/ft (2,700 kN-m/m)).
j. ASTM D2487 – Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
k. ASTM D2488 – Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).
l. ASTM D3080 – Standard Test Method for Direct Shear Test of Soils Under Consolidated Drained Conditions.
m. ASTM D4254 – Standard Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
n. ASTM D4318 – Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
o. ASTM D4767- Test Method for Consolidated-Undrained Triaxial Compression Test for Cohesive Soils.
p. ASTM D4972 – Standard Test Method for pH of Soils.
q. ASTM D6913 – Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis.
r. ASTM D6938 – Standard Test Method for In-Place Density and Water Content of Soil and Aggregate by Nuclear Methods (Shallow Depth).
s. ASTM G51 – Standard Test Method for Measuring pH of Soil for Use in Corrosion Testing.
t. ASTM G57 – Standard Test Method for Field Measurement of Soil Resistivity Using the Wenner Four-Electrode Method.

5. Drainage Pipe
   a. ASTM D3034 – Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
   b. ASTM F2648 – Standard Specification for 2 to 60 inch [50 to 1500 mm] Annular Corrugated Profile Wall Polyethylene (PE) Pipe and Fittings for Land Drainage Applications.

1.04 ADMINISTRATIVE REQUIREMENTS

A. The General Contractor may choose to self-perform any or all of the work, and the Earthwork and Grading Contractor may or may not also be the RWIC. Also, the project Civil Engineer or the project Geotechnical Engineer may or may not also be the RWDE.
B. Preconstruction Meeting. As directed by the Owner, the General Contractor shall schedule a preconstruction meeting at the project site prior to commencement of retaining wall construction. Participation in the preconstruction meeting shall be required of the General Contractor, the Retaining Wall Design Engineer (RWDE), the Retaining Wall Installation Contractor (RWIC), the Earthwork/Grading Contractor, and the Qualified Inspection Engineer. The General Contractor shall provide notification to all parties at least 10 calendar days prior to the meeting.

   1. Preconstruction Meeting Agenda:

a. The RWDE shall be provided the opportunity to explain all aspects of the retaining wall construction drawings.
b. The RWDE shall communicate the required bearing capacity of the soil below the retaining wall structure and the shear strength of in-situ soils assumed in the retaining wall design to the Inspection Engineer.
c. The RWDE shall explain the required shear strength of fill soil in the retained and foundation zones of the retaining wall to the Inspection Engineer.
d. The RWDE shall explain any measures required for coordination of the installation of utilities or other obstructions in the retained fill zones of the retaining wall.
e. The RWIC shall explain all excavation needs, site access and material staging area requirements to the General Contractor and Earthwork/Grading Contractor.

1.05 SUBMITTALS

A. Product Data. At least 14 days prior to construction, the General Contractor shall submit the retaining wall product submittal package to the Owner's Representative for review and approval. The submittal package shall include technical specifications and product data from the manufacturer for the following:
   1. Precast Modular Block System brochure
   2. Precast Modular Block concrete test results specified in Part 2.01, Paragraph B of this section as follows:
      a. 28-day compressive strength
      b. Air content
      c. Slump or Slump Flow (as applicable)
   3. Drainage Pipe
   4. Geotextile

B. Installer Qualification Data. At least 14 days prior to construction, the General Contractor shall submit the qualifications of the business entity responsible for installation of the retaining wall, the RWIC, per Part 1.07, Paragraph A of this section.

C. Retaining Wall Design Calculations and Construction Shop Drawings. Prior to construction, the General Contractor shall furnish construction shop drawings and the supporting structural calculations report to the Owner for review and approval. Unless specifically requested by the Owner, the submittal may be in electronic format. This submittal shall include the following:
   1. Signed, sealed and dated drawings and engineering calculations prepared in accordance with these specifications.
   2. Qualifications Statement of Experience of the RWDE as specified in Part 1.07, subparagraph B of this section.
   3. Certificate of Insurance of the RWDE as specified in Part 1.06, Paragraph B of this section.

1.06 CONSTRUCTION SHOP DRAWING PREPARATION

A. The RWDE shall coordinate the retaining wall construction shop drawing preparation with the project Civil Engineer, project Geotechnical Engineer and Owner's Representatives. The General Contractor shall furnish the RWDE the following project information required to prepare the construction shop drawings. This information shall include, but is not limited to, the following:

1. Current versions of the site, grading, drainage, utility, erosion control, landscape, and irrigation plans;
2. electronic CAD file of the civil site plans listed in (1);
3. report of geotechnical investigation and all addenda and supplemental reports;
4. recommendations of the project Geotechnical Engineer regarding effective stress shear strength and total stress shear strength (when applicable) parameters for in-situ soils in the vicinity of the proposed retaining wall(s) and for any fill soil that may potentially be used as backfill in retained and/or foundation zones of the retaining wall.
5. Information pertaining to the magnitude, location, and nature of surcharge loadings acting on or near the proposed wall.

B. The RWDE shall provide the Owner with a certificate of professional liability insurance verifying the minimum coverage limits of $1 million per claim and $1 million aggregate.

C. Design of the precast modular block retaining wall shall satisfy the requirements of this section. Where local design or building code requirements exceed these specifications, the local requirements shall also be satisfied.

D. The RWDE shall note any exceptions to the requirements of this section by listing them at the bottom right corner of the first page of the construction shop drawings.

E. Approval or rejection of the exceptions taken by the Retaining Wall Engineer will be made in writing as directed by the Owner.

F. The RWDE shall determine the appropriate standard(s) to be utilized, and to which the precast modular block design shall be based upon, except as noted herein. Refer to Part 1.03, Paragraph C, Part 1. Some project Owners may also specify which standard shall be used.

G. In the event that a conflict is discovered between these specifications and a reasonable interpretation of the design specifications and methods referenced in Paragraph F above, these specifications shall prevail. If a reasonable interpretation is not possible, the conflict shall be resolved per the requirements in Part 1.03, Paragraph A of this section.

H. Soil Shear Parameters. The RWDE shall prepare the construction shop drawings based upon soil shear strength parameters from the available project data and the recommendations of the project Geotechnical Engineer. If insufficient data exists to develop the retaining wall design, the RWDE shall communicate the specific deficiency of the project information or data to the Owner in writing.

I. Allowable bearing pressure requirements for each retaining wall shall be clearly shown on the construction drawings.

J. Global Stability. Overall (global) stability shall be evaluated in accordance with the principals of limit equilibrium analysis as set forth in the approved standards, as determined by the RWDE, as referenced in Section 1.06, Part F. The minimum recommended factors of safety shall be as follows, or as otherwise selected as appropriate by the RWDE:

Normal Service (static)	1.3 to 1.5*
Seismic	1.1
Rapid Drawdown (if applicable)	1.2

*High uncertainty/variability, wall supporting critical or sensitive facilities: 1.5, low uncertainty/variability, wall not supporting critical or sensitive facilities: 1.3

K. Seismic Stability. Seismic loading shall be evaluated in accordance with AASHTO Load and Resistance Factor Design (LRFD) methodology, or NCMA Allowable Stress Design (ASD) methodology as determined by the RWDE as referenced in Section 1.06, Part F.

1.07 QUALITY ASSURANCE

A. RWIC Qualifications. In order to demonstrate basic competence in the construction of precast modular block walls, the RWIC shall document compliance with the following:
   1. Experience.
      a. Construction experience with a minimum of 3,000 square feet (280 square meters) of the proposed precast modular block retaining wall system.
      b. Construction of at least three (3) precast modular block (large block) retaining wall structures within the past three (3) years.
      c. Construction of at least 5,000 square feet (465 square meters) of precast modular block (large block) retaining walls within the past five (5) years.
   2. RWIC experience documentation for each qualifying project shall include:
      a. Project name and location
      b. Date (month and year) of construction completion
      c. Contact information of Owner or General Contractor
      d. Type (trade name) of precast modular block system used
      e. Maximum height of the wall constructed
      f. Face area of the wall constructed
   3. In lieu of the requirements set forth in items 1 and 2 above, the RWIC must submit documentation demonstrating competency in precast modular block retaining wall construction through a training program that is deemed acceptable by the Owner.

B. RWDE Qualifications and Statement of Experience. The RWDE shall submit a written statement affirming that he or she has the following minimum qualifications and experience.
   1. The RWDE shall be licensed to practice in the jurisdiction of the project location.
   2. The RWDE shall be independently capable of performing all internal and external stability analyses, including those for seismic loading, compound stability, rapid draw-down and deep-seated, global modes of failure. The project geotechnical engineer may provide global stability analysis.
   3. The RWDE shall affirm in writing that he or she has personally supervised the design of the retaining walls for the project, that the design considers all the requirements listed in paragraph 1.06 and that he or she accepts responsibility as the design engineer of record for the retaining walls constructed on the project.
   4. The RWDE shall affirm in writing that he or she has designed a minimum of approximately 3,000 face square feet (280 face square meters) of modular block earth retaining walls within the previous five (5) years.
   5. In lieu of these specific requirements, the engineer may submit alternate documentation demonstrating competency in Precast Modular Block retaining wall design.

C. The Owner reserves the right to reject the design services of any engineer or engineering firm who, in the sole opinion of the Owner, does not possess the requisite experience or qualifications.

1.08 QUALITY CONTROL

A. The Owner's Representative shall review all submittals for materials, design, RWDE qualifications and the RWIC qualifications.

B. The Owner's Representative shall retain the services of an Inspection Engineer who is experienced with the construction of precast modular block retaining wall structures to perform inspection and testing. The cost of inspection shall be the responsibility of the Owner. Inspection shall be continuous throughout the construction of the retaining walls.

C. The Inspection Engineer shall perform the following duties:
   1. Inspect the construction of the precast modular block structure for conformance with construction shop drawings and the requirements of this specification.
   2. Verify that soil or aggregate fill placed and compacted in the retained and foundation zones of the retaining wall conforms with paragraphs 2.04 and 2.05 of this section and exhibits the shear strength and bearing capacity parameters specified by the RWDE.
   3. Verify that the shear strength of the in-situ soil assumed by the RWDE is appropriate.
   4. Inspect and document soil compaction in accordance with these specifications:
      a. Required dry unit weight
      b. Actual dry unit weight
      c. Allowable moisture content
      d. Actual moisture content
      e. Pass/fail assessment
      f. Test location – wall station number
      g. Test elevation
      h. Distance of test location behind the wall face
   5. Verify that all excavated slopes in the vicinity of the retaining wall are bench-cut as directed by the project Geotechnical Engineer.
   6. Notify the RWIC of any deficiencies in the retaining wall construction and provide the RWIC a reasonable opportunity to correct the deficiency.
   7. Notify the General Contractor, Owner and RWDE of any construction deficiencies that have not been corrected timely.
   8. Document all inspection results.
   9. Test compacted density and moisture content of the retained backfill with the following frequency:
      a. At least once every 500 square feet (45 square meters) (in plan) per vertical lift, and
      b. At least once per every 18 inches (460 mm) of vertical wall construction.

D. The Owner's engagement of the Inspection Engineer does not relieve the RWIC of responsibility to construct the proposed retaining wall in accordance with the approved construction shop drawings and these specifications.

E. The RWIC shall inspect the on-site grades and excavations prior to construction and notify the RWDE and General Contractor if on-site conditions differ from the elevations, assumptions, grading, and soil and groundwater conditions depicted in the retaining wall construction shop drawings.

1.09 DELIVERY, STORAGE AND HANDLING

A. The RWIC shall inspect the materials upon delivery to ensure that the proper type, grade and color of materials have been delivered.

B. The RWIC shall store and handle all materials in accordance with the manufacturer's recommendations as specified herein and in a manner that prevents deterioration or damage due to moisture, temperature changes, contaminants, corrosion, breaking, chipping, UV exposure or other causes. Damaged materials shall not be incorporated into the work.

C. Geosynthetics
   1. All geosynthetic materials shall be handled in accordance with ASTM D4873. The materials should be stored off the ground and protected from precipitation, sunlight, dirt and physical damage.

D. Precast Modular Blocks
   1. Precast modular blocks shall be stored in an area with positive drainage away from the blocks. Be careful to protect the block from mud and excessive chipping and breakage. Precast modular blocks shall not be stacked more than three (3) units high in the storage area.

E. Drainage Aggregate and Backfill Stockpiles
   1. Drainage aggregate or backfill material shall not be piled over unstable slopes or areas of the project site with buried utilities.
   2. Drainage aggregate material shall not be staged where it may become mixed with or contaminated by poor draining fine-grained soils such as clay or silt.

PART 2 – MATERIALS

2.01 PRECAST MODULAR BLOCK RETAINING WALL UNITS

A. All units shall be wet-cast precast modular retaining wall units conforming to ASTM C1776.

B. All units for the project shall be obtained from the same manufacturer. The manufacturer shall be licensed and authorized to produce the retaining wall units by the precast modular block system patent holder/licensor and shall document compliance with the published quality control standards of the proprietary precast modular block system licensor for the previous three (3) years, or the total time the manufacturer has been licensed, whichever is less.

C. Concrete used in the production of the precast modular block units shall be first-purpose, fresh concrete. It shall not consist of returned, reconstituted, surplus or waste concrete. It shall be an original production mix meeting the requirements of ASTM C94 and exhibit the properties as shown in the following table:

Concrete Mix Properties

Freeze Thaw Exposure Class[1]	Minimum 28-Day Compressive Strength[2]	Maximum Water Cement Ratio	Nominal Maximum Aggregate Size	Aggregate Class Designation[3]	Air Content[4]
Moderate	4,000 psi (27.6 MPa)	0.45	1 inch (25 mm)	3M	4.5% +/- 1.5%
Severe	4,000 psi (27.6 MPa)	0.45	1 inch (25 mm)	3S	6.0% +/- 1.5%
Very Severe	4,500 psi (30.0 MPa)	0.40	1 inch (25 mm)	4S	6.0% +/- 1.5%
Maximum Water-Soluble Chloride Ion (Cl^-) Content in Concrete, Percent by Weight of Cement[5,6]					0.15
Maximum Chloride as Cl^- Concentration in Mixing Water, Parts Per Million					1000
Maximum Percentage of Total Cementitious Materials By Weight [7,9] (Very Severe Exposure Class Only):					
Fly Ash or Other Pozzolans Conforming to ASTM C618					25
Slag Conforming to ASTM C989					50
Silica Fume Conforming to ASTM C1240					10
Total of Fly Ash or Other Pozzolans, Slag, and Silica Fume[8]					50
Total of Fly Ash or Other Pozzolans and Silica Fume[8]					35
Alkali-Aggregate Reactivity Mitigation per ACI 201					
Slump (Conventional Concrete) per ASTM C143[10]			5 inches +/- 1½ inches (125 mm +/- 40 mm)		
Slump Flow (Self-Consolidating Concrete) per ASTM C1611			18 inches – 32 inches (450 mm – 800 mm)		

[1]Exposure class is as described in ACI 318. "Moderate" describes concrete that is exposed to freezing and thawing cycles and occasional exposure to moisture. "Severe" describes concrete that is exposed to freezing and thawing cycles and in continuous contact with moisture. "Very Severe" describes concrete that is exposed to freezing and thawing cycles and in continuous contact with moisture and exposed to deicing chemicals. Exposure class should be specified by owner/purchaser prior to order placement.

[2]Test method ASTM C39.

[3]Defined in ASTM C33 Table 3 *Limits for Deleterious Substances and Physical Property Requirements of Coarse Aggregates for Concrete*.

[4]Test method ASTM C231.

[5]Test method ASTM C1218 at age between 28 and 42 days.

[6]Where used in high sulfate environments or where alkali-silica reactivity is an issue, water soluble chloride shall be limited to no more than trace amounts (from impurities in concrete-making components, not intended constituents.)

[7]The total cementitious material also includes ASTM C150, C595, C845, C1157 cement. The maximum percentages shall include:

(a) Fly ash or other pozzolans in type IP, blended cement, ASTM C595, or ASTM C1157.
(b) Slag used in the manufacture of an IS blended cement, ASTM C595, or ASTM C1157.
(c) Silica fume, ASTM C1240, present in a blended cement.

[8]Fly ash or other pozzolans and silica fume shall constitute no more than 25 and 10 percent, respectively, of the total weight of the cementitious materials.

[9]Prescriptive limits shown may be waived for concrete mixes that demonstrate excellent freeze/thaw durability in a detailed and current testing program.

[10]Slump may be increased by a high-range water-reducing admixture.

D. Each concrete block shall be cast in a single continuous pour without cold joints. With the exception of half-block units, corner units and other special application units, the precast modular block units shall conform to the nominal dimensions listed in the table below and be produced to the dimensional tolerances shown.

Block Type	Dimension	Nominal Value	Tolerance
28” (710 mm) Block	Height	18” (457 mm)	+/- 3/16” (5 mm)
	Length	46-1/8” (1172 mm)	+/- 1/2” (13 mm)
	Width*	28” (710 mm)	+/- 1/2” (13 mm)
41” (1030 mm) Block	Height	18” (457 mm)	+/- 3/16” (5 mm)
	Length	46-1/8” (1172 mm)	+/- 1/2” (13 mm)
	Width*	40-1/2” (1030 mm)	+/- 1/2” (13 mm)
60” (1520 mm) Block	Height	18” (457 mm)	+/- 3/16” (5 mm)
	Length	46-1/8” (1172 mm)	+/- 1/2” (13 mm)
	Width*	60” (1520 mm)	+/- 1/2” (13 mm)
52” (1320 mm) XL Block	Height	36” (914 mm)	+/- 3/16” (5 mm)
	Length	46-1/8” (1172 mm)	+/- 1/2” (13 mm)
	Width*	52” (1320 mm)	+/- 1/2” (13 mm)
72” (1830 mm) XL Block	Height	36” (914 mm)	+/- 3/16” (5 mm)
	Length	46-1/8” (1172 mm)	+/- 1/2” (13 mm)
	Width*	72” (1830 mm)	+/- 1/2” (13 mm)
96” (2440 mm) XL Block	Height	36” (914 mm)	+/- 3/16” (5 mm)
	Length	46-1/8” (1172 mm)	+/- 1/2” (13 mm)
	Width*	96” (2440 mm)	+/- 1/2” (13 mm)

* Block tolerance measurements shall exclude variable face texture

E. Individual block units shall have a nominal height of 18 inches (457 mm), or 36 inches (914 mm) for XL blocks.

F. With the exception of half-block units, corner units and other special application units, the precast modular block units shall have two (2), circular dome shear knobs that are 10 inches (254 mm), 7.5 inches (190 mm), or 6.75 inches (171 mm) in diameter and 4 inches (102 mm) or 2 inches (51 mm) in height. The shear knobs shall fully index into a continuous semi-cylindrical shear channel in the bottom of the block course above. The peak interface shear between any two (2) vertically stacked precast modular block units, with 10 inch (254 mm) diameter shear knobs, measured in accordance with ASTM D6916 shall exceed 6,500 lb/ft (95 kN/m) at a minimum normal load of 500 lb/ft (7kN/m). as well as an ultimate peak interface shear capacity in excess of 11,000 lb/ft (160 kN/m). The peak interlock shear between any two (2) vertically stacked precast modular block units, with 7.5 inch (190 mm) or 6.75 inch (171 mm) diameter shear knobs, measured in accordance with ASTM D6916 shall exceed 1,850 lb/ft (27 kN/m) at a minimum normal load of 500 lb/ft (7kN/m) as well as an ultimate peak interface shear capacity in excess of 10,000 lb/ft (146 kN/m).Test specimen blocks tested under ASTM D6916 shall be actual, full-scale production blocks of known compressive strength. The interface shear capacity reported shall be corrected for a 4,000 psi (27.6 MPa) concrete compressive strength. Regardless of precast modular block configuration, interface shear testing shall be completed without the inclusion of unit core infill aggregate.

G. In certain configurations and/or combinations of blocks, some minor on-site trimming/partial removal of some of the shear knobs may be necessary to allow for proper alignment.

H. The 28” (710 mm) and 41” (1030 mm) precast modular block units may be cast with a 13” (330 mm) wide, continuous vertical core slot completely through the block, or solid concrete.

I. Without field cutting or special modification, the precast modular block units shall be capable of achieving a minimum radius of 14 ft 6 in (4.42 m).

J. The precast modular block units shall be manufactured with integrally cast shear knobs that establish a standard horizontal set-back for subsequent block courses. The precast modular block system shall be available in the four (4) standard horizontal set-back facing batter options listed below:

18-inch High Blocks:		36-inch High Blocks:	
Horizontal Set-Back/Blk. Course	Max. Facing Batter	Horizontal Set-Back/Blk. Course	Max. Facing Batter
3/8" (10 mm)	1.2˚	3-1/4" (83 mm)	5.2˚
1-5/8" (41 mm)	5.2˚		
9-3/8" (238 mm)	27.5˚		
16-5/8" (422 mm)	42.7˚		

The precast modular block units shall be furnished with the required shear knobs that provide the facing batter required in the construction shop drawings.

K. The precast modular block unit face texture shall be selected by the Owner from the available range of textures available from the precast modular block manufacturer. Each textured block facing unit shall be a minimum of 5.76 square feet (0.54 square meters) with a unique texture pattern that repeats with a maximum frequency of once in any 15 square feet (1.4 square meters) of wall face.

L. The block color shall be selected by the Owner from the available range of colors available from the precast modular block manufacturer. Concrete blocks can also be stained after installation based upon Owner's selection of concrete stain colors.

M. All precast modular block units shall be sound and free of cracks or other defects that would interfere with the proper installation of the unit, impair the strength or performance of the constructed wall. PMB units to be used in exposed wall construction shall not exhibit chips or cracks in the exposed face or faces of the unit that are not otherwise permitted. Chips smaller than 1.5" (38 mm) in its largest dimension and cracks not wider than 0.012" (0.3 mm) and not longer than 25% of the nominal height of the PMB unit shall be permitted. PMB units with bug holes in the exposed architectural face smaller than 0.75" (19 mm) in its largest dimension shall be permitted. Bug holes, water marks, and color variation on non-architectural faces are acceptable. PMB units that exhibit cracks that are continuous through any solid element of the PMB unit shall not be incorporated in the work regardless of the width or length of the crack.

N. Preapproved Manufacturers.
Manufacturers of Redi-Rock Retaining Wall Systems as licensed by Redi-Rock International, LLC, 2940 Parkview Drive, Petoskey, MI 49770 USA; telephone (866) 222-8400; website: www.redi-rock.com.

O. Substitutions. Technical information demonstrating conformance with the requirements of this specification for an alternative precast modular block retaining wall system must be submitted for preapproval at least 14 calendar days prior to the bid date. Acceptable alternative PMB retaining wall systems, otherwise found to be in conformance with this specification, shall be approved in writing by the Owner 7 days prior to the bid date. The Owner's Representative reserves the right to provide no response to submissions made outside of the time requirements of this section or to submissions of block retaining wall systems that are determined to be unacceptable to the Owner.

P. Value Engineering Alternatives. The Owner may evaluate and accept systems that meet the requirements of this specification after the bid date that provide a minimum cost savings of 20% to the Owner. Construction expediency will not be considered as a contributing portion of the cost savings total.

2.02 GEOTEXTILE

A. Nonwoven geotextile fabric shall be placed as indicated on the retaining wall construction shop drawings. Additionally, the nonwoven geotextile fabric shall be placed in the v-shaped joint between adjacent block units on the same course. The nonwoven geotextile fabric shall meet the requirements Class 3 construction survivability in accordance with AASHTO M 288.

B. Preapproved Nonwoven Geotextile Products
1. Mirafi 140N
2. Propex Geotex 451
3. Skaps GT-142
4. Thrace-Linq 140EX
5. Carthage Mills FX-40HS
6. Stratatex ST 142

2.03 DRAINAGE AGGREGATE AND WALL INFILL

A. Drainage aggregate (and wall infill for retaining walls designed as modular gravity structures) shall be a durable crushed stone conforming to No. 57 size per ASTM C33 with the following particle-size distribution requirements per ASTM D6913:

U.S. Standard Sieve Size	% Passing
1-½" (38 mm)	100
1" (25 mm)	95-100
½" (13 mm)	25-60
No. 4 (4.76 mm)	0-10
No. 8 (2.38 mm)	0-5

2.04 LEVELING PAD

A. The precast modular block units shall be placed on a leveling pad constructed from crushed stone or unreinforced concrete. The leveling pad shall be constructed to the dimensions and limits shown on the retaining wall design drawings prepared by the RWDE.

B. Crushed stone used for construction of a granular leveling pad shall meet the requirements of the drainage aggregate and wall infill in section 2.04 or a preapproved alternate material.

C. Concrete used for construction of an unreinforced concrete leveling pad shall satisfy the criteria for AASHTO Class B. The concrete should be cured a minimum of 12 hours prior to placement of the precast modular block wall retaining units and exhibit a minimum 28-day compressive strength of 2,500 psi (17.2 MPa).

2.05 DRAINAGE

A. Drainage Pipe
   1. Drainage collection pipe shall be a 4” (100 mm) diameter, 3-hole perforated, HDPE pipe with a minimum pipe stiffness of 22 psi (152 kPa) per ASTM D2412.
   2. The drainage pipe shall be manufactured in accordance with ASTM D1248 for HDPE pipe and fittings.

B. Preapproved Drainage Pipe Products
   1. ADS 3000 Triple Wall pipe as manufactured by Advanced Drainage Systems.

PART 3 – EXECUTION

3.01 GENERAL

A. All work shall be performed in accordance with OSHA, State, and local safety standards, state and local building codes and manufacturer’s requirements.

B. The General Contractor is responsible for the location and protection of all existing underground utilities. Any new utilities proposed for installation in the vicinity of the retaining wall, shall be installed concurrent with retaining wall construction. The General Contractor shall coordinate the work of subcontractors affected by this requirement.

C. New utilities installed below the retaining wall shall be backfilled and compacted to a minimum of 98% maximum dry density per ASTM D698 standard proctor.

D. The General Contractor is responsible to ensure that safe excavations and embankments are maintained throughout the course of the project.

E. All work shall be inspected by the Inspection Engineer as directed by the Owner.

3.02 EXAMINATION

A. Prior to construction, the General Contractor, Grading Contractor, RWIC and Inspection Engineer shall examine the areas in which the retaining wall will be constructed to evaluate compliance with the requirements for installation tolerances, worker safety and any site conditions affecting performance of the completed structure. Installation shall proceed only after unsatisfactory conditions have been corrected.

3.03 PREPARATION

A. Fill Soil.
   1. The Inspection Engineer shall verify that retained backfill material placed within a horizontal distance of one (1.0) times the wall height behind the wall blocks satisfies the criteria of this section.
   2. The Inspection Engineer shall verify that any fill soil installed in the foundation and retained soil zones of the retaining wall satisfies the specification of the RWDE as shown on the construction drawings.

B. Excavation.

1. The Grading Contractor shall excavate to the lines and grades required for construction of the precast modular block retaining wall as shown on the construction drawings. The Grading Contractor shall minimize over-excavation. Excavation support, if required, shall be the responsibility of the Grading Contractor.
2. Over-excavated soil shall be replaced with compacted fill in conformance with the specifications of the RWDE and "Division 31, Section 31 20 00 – Earthmoving" of these project specifications.
3. Embankment excavations shall be bench cut as directed by the project Geotechnical Engineer and inspected by the Inspection Engineer for compliance.

C. Foundation Preparation.
1. Prior to construction of the precast modular block retaining wall, the leveling pad area and undercut zone (if applicable) shall be cleared and grubbed. All topsoil, brush, frozen soil and organic material shall be removed. Additional foundation soils found to be unsatisfactory beyond the specified undercut limits shall be undercut and replaced with approved fill as directed by the project Geotechnical Engineer. The Inspection Engineer shall ensure that the undercut limits are consistent with the requirements of the project Geotechnical Engineer and that all soil fill material is properly compacted in accordance with project specifications. The Inspection Engineer shall document the volume of undercut and replacement, if required.
2. Following excavation for the leveling pad and undercut zone (if applicable), the Inspection Engineer shall evaluate the in-situ soil in the foundation and retained soil zones.
    a. The Inspection Engineer shall verify that the shear strength of the in-situ soil assumed by the RWDE is appropriate. The Inspection Engineer shall immediately stop work and notify the Owner if the in-situ shear strength is found to be inconsistent with the retaining wall design assumptions.
    b. The Inspection Engineer shall verify that the foundation soil exhibits sufficient ultimate bearing capacity to satisfy the requirements indicated on the retaining wall construction shop drawings per paragraph 1.06 I of this section.

D. Leveling Pad.
1. The leveling pad shall be constructed to provide a level, hard surface on which to place the first course of precast modular block units. The leveling pad shall be placed in the dimensions shown on the retaining wall construction drawings and extend to the limits indicated.
2. Crushed Stone Leveling Pad. Crushed stone shall be placed in uniform maximum lifts of 6" (150 mm). The crushed stone shall be compacted by a minimum of 3 passes of a vibratory compactor capable of exerting 2,000 lb (8.9 kN) of centrifugal force and to the satisfaction of the Inspection Engineer.
3. Unreinforced Concrete Leveling Pad. The concrete shall be placed in the same dimensions as those required for the crushed stone leveling pad. The RWIC shall erect proper forms as required to ensure the accurate placement of the concrete leveling pad according to the retaining wall construction drawings.

3.04 PRECAST MODULAR BLOCK WALL SYSTEM INSTALLATION

A. The precast modular block structure shall be constructed in accordance with the construction drawings, these specifications and the recommendations of the retaining wall system component manufacturers. Where conflicts exist between the manufacturer's recommendations and these specifications, these specifications shall prevail.

B. Drainage components. Pipe, geotextile and drainage aggregate shall be installed as shown on the construction shop drawings.

C. Precast Modular Block Installation
   1. The first course of block units shall be placed with the front face edges tightly abutted together on adjacent blocks, on the prepared leveling pad at the locations and elevations shown on the construction drawings. The RWIC shall take special care to ensure that the bottom course of block units are in full contact with the leveling pad, are set level and true and are properly aligned according to the locations shown on the construction drawings.
   2. Backfill shall be placed in front of the bottom course of blocks prior to placement of subsequent block courses. Nonwoven geotextile fabric shall be placed in the V-shaped joints between adjacent blocks. Drainage aggregate shall be placed in the V-shaped joints between adjacent blocks, and extend to a minimum distance of 12” (300 mm) behind the block unit.
   3. Drainage aggregate shall be placed in 9 inch to 12 inch maximum lifts (as specified by the Engineer) and compacted by a minimum of three (3) passes of a vibratory plate compactor capable exerting a minimum of 2,000 lb (8.9 kN) of centrifugal force, or by other suitable compaction methods.
   4. Unit core fill shall be placed in the precast modular block unit vertical core slot. The core fill shall completely fill the slot to the level of the top of the block unit. The top of the block unit shall be broom-cleaned prior to placement of subsequent block courses. No additional courses of precast modular blocks may be stacked before the unit core fill is installed in the blocks on the course below.
   5. Base course blocks for gravity wall designs (without geosynthetic soil reinforcement) may be furnished without vertical core slots. If so, disregard item 4 above, for the base course blocks in this application.
   6. Nonwoven geotextile fabric shall be placed between the drainage aggregate and the retained soil (gravity wall design) if required on the retaining wall construction drawings.
   7. Subsequent courses of block units shall be installed with a running bond (approximate half block horizontal course-to-course offset). With the exception of 90 degree corner units, the shear channel of the upper block shall be fully engaged with the shear knobs of the block course below. The upper block course shall be pushed forward to fully engage the interface shear key between the blocks and to ensure consistent face batter and wall alignment. Drainage aggregate, unit core fill, geotextile and properly compacted backfill shall be complete and in-place for each course of block units before the next course of blocks is stacked.
   8. The elevation of retained soil fill shall not be less than 1 block course (18” (457 mm)) below the elevation of the retained backfill throughout the construction of the retaining wall.
   9. If included as part of the precast modular block wall design, cap units shall be secured with an appropriate construction adhesive in accordance with the Manufacturer’s recommendation.

D. Construction Tolerance. Allowable construction tolerance of the retaining wall shall be as follows:
   1. Deviation from the design batter and horizontal alignment, when measured along a 10’ (3 m) straight wall section, shall not exceed 3/4” (19 mm).
   2. Deviation from the overall design batter shall not exceed 1/2“ (13 mm) per 10’ (3 m) of wall height.
   3. The maximum allowable offset (horizontal bulge) of the face in any precast modular block joint shall be 1/2” (13 mm).
   4. The base of the precast modular block wall excavation shall be within 2” (50 mm) of the staked elevations, unless otherwise approved by the Inspection Engineer.

5. Differential vertical settlement of the face shall not exceed 1’ (300 mm) along any 200’ (61 m) of wall length.
6. The maximum allowable vertical displacement of the face in any precast modular block joint shall be 1/2“ (13 mm).
7. The wall face shall be placed within 2” (50 mm) of the horizontal location staked.

3.05 WALL INFILL AND BACKFILL PLACEMENT

A. Backfill material placed immediately behind the drainage aggregate shall be compacted as follows:
   1. 98% of maximum dry density at ± 2% optimum moisture content per ASTM D698 standard proctor or 85% relative density per ASTM D4254.

B. Compactive effort within 3’ (0.9 m) of the back of the precast modular blocks should be accomplished with walk-behind compactors. Compaction in this zone shall be within 95% of maximum dry density as measured in accordance with ASTM D1557 modified proctor or 80% relative density per ASTM D 4254. Heavy equipment should not be operated within 3’ (0.9 m) of the back of the precast modular blocks.

C. Backfill material shall be installed in lifts that do not exceed a thickness of 9 to 12 inches (230 to 330 mm), as specified by Engineer.

D. At the end of each work day, the RWIC shall grade the surface of the last lift of the granular wall infill to a 3% ± 1% slope away from the precast modular block wall face and compact it.

E. The General Contractor shall direct the Grading Contractor to protect the precast modular block wall structure against surface water runoff at all times through the use of berms, diversion ditches, silt fence, temporary drains and/or any other necessary measures to prevent soil staining of the wall face, scour of the retaining wall foundation or erosion of the reinforced backfill or wall infill.

3.06 OBSTRUCTIONS IN THE INFILL ZONE

A. The RWIC shall make all required allowances for obstructions behind and through the wall face in accordance with the approved construction shop drawings.

B. Should unplanned obstructions become apparent for which the approved construction shop drawings do not account, the affected portion of the wall shall not be constructed until the RWDE can appropriately address the required procedures for construction of the wall section in question.

3.07 COMPLETION

A. For walls supporting unpaved areas, a minimum of 12” (300 mm) of compacted, low-permeability fill shall be placed over the granular wall infill zone of the precast modular block retaining wall structure. The adjacent retained soil shall be graded to prevent ponding of water behind the completed retaining wall.

B. For retaining walls with crest slopes of 5H:1V or steeper, appropriate soil erosion/sedimentation control measures shall be installed along the wall crest immediately following construction and grading of the crest slope. The crest slope above the wall shall be immediately seeded and

protected to establish vegetation. The General Contractor shall ensure that the seeded slope receives adequate irrigation and erosion protection to support germination and growth.

C. The General Contractor shall confirm that the as-built precast modular block wall geometries conform to the requirements of this section. The General Contractor shall notify the Owner of any deviations.

END OF SECTION 32 32 15

SECTION 32 90 00

PLANTING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Work necessary to restore all disturbed surfaces and facilities to equal or better condition.
   2. Provide, establish, and maintain seed, fertilizer, mulch, and erosion control materials.

B. Related Sections
   01 20 00 - PRICE AND PAYMENT PROCEDURE
   31 00 00 - EARTHWORK
   31 25 00 - EROSION AND SEDIMENTATION CONTROL

1.02 UNIT PRICES

All work under this Section shall be considered incidental to the work unless specifically indicated on the BID SCHEDULE and referred to in Section 01 20 00 - PRICE AND PAYMENT PROCEDURE.

PART 2 PRODUCTS

2.01 MATERIALS

A. Topsoil: Provide topsoil as specified in Section 31 00 00 - EARTHWORK.

B. Seed: Provide seed mixture composed of the following proportion by weight:

Creeping Red Fescue	35%
Kentucky Blue Grass	15%
Perennial Rye Grass	50%

C. Fertilizer:
   1. Provide chemical fertilizer with a 12-12-12 mixture of Nitrogen (N), Phosphoric Acid (P_2O_5), and Potash (K_2O).
   2. Provide net weight of contents and guaranteed analysis.

D. Mulching: Provide straw, hay, or other material conforming to MDOT Specification 8.21.11, as approved by the Engineer.

PART 3 EXECUTION

3.01 TOPSOIL PREPARATION

A. General:
   1. Prepare topsoil after finish grading of surfaces.
   2. Prepare soil to a friable condition by discing, harrowing, or otherwise loosening the soil to a depth of 3 inches.
   3 Break up all lumps of soil.
   4. Rake out all rocks and debris.

3.02 FERTILIZING

A. Apply evenly on the prepared surface at a rate of 240 pounds per acre.

B. Drill or broadcast method, placed no deeper than 1 inch.

3.03 SOWING

A. Sow grass at a minimum rate of 100 pounds per acre.

B. Method:
1. Sow the seed following or in conjunction with the fertilizer.
2. Sow only while soil is in a friable condition.
3. Do not sow through mulch.
4. Sow seed mixture by drill or broadcast method.
5. Float seed sown by broadcast method so that 50% of the seed is mixed with the top 2 inch of the soil.

C. Hydroseeding:
1. Apply seed, fertilizer, and mulch in one application.
2. Mulch shall be a wood fiber material.
3. Apply at a rate of 1440 pounds per acre.

D. Watering:
1. Water all seeded areas to establish a smooth and full vegetative cover.
2. Should erosion occur or the seed not grow within the guarantee period, regrade and reseed the disturbed area at no additional cost.

E. Erosion control:
1. Provide measures necessary to establish well rooted vegetation on slopes and ditch bottoms.
2. Protect seeded slopes with netted mulch blankets or other suitable methods.

F. Seasonal limitations:
1. Apply seed between May 1 and October 1.
2. Dormant seeding:
a. Permitted in limited areas to complete a project.
b. Apply after November 1, but not on frozen ground.

3.04 MULCHING

A. Apply at a rate of 2 bales per 1000 square feet.

B. Method:
1. Apply immediately after seeding.
2. Apply evenly and loose enough to allow sunlight and air to penetrate, but thick enough to reduce the rate of evaporation and erosion.
3. Apply mulch adhesive as necessary at a rate of 150 gallons per acre.

END OF SECTION

SECTION 33 14 16
SITE WATER UTILITY DISTRIBUTION

PART 1 GENERAL

1.01 SECTION INCLUDES

Provide all labor, tools, equipment, and testing necessary for the installation of all water main and appurtenances and related sections. Installation of backflow prevention may be necessary. Winterization capabilities are required where the new 1 1/2” water service is tapped into the main distribution line.

1.02 RELATED SECTIONS

01 20 00 - PRICE AND PAYMENT PROCEDURE
31 00 00 - EARTHWORK

1.03 UNIT PRICES

Refer to Section 01 20 00 - PRICE AND PAYMENT PROCEDURE

1.04 REFERENCED STANDARDS

Unless otherwise specified, the work for this Section shall conform to the applicable portions of the following Standard Specification:

ANSI - American National Standards Institute
ASTM - American Society for Testing and Materials
AWWA - American Water Works Association
NSF - National Sanitation Foundation

1.05 SUBMITTALS

Submit complete sets of shop drawings and product data to the ENGINEER for review and approval, prior to ordering any material.

1.06 DELIVERY, STORAGE AND HANDLING

A. Piping shall not be stacked higher than four feet. Suitable racks, chairs and other supports shall be provided to protect pipe mating surfaces from damage. Store bottom tiers off the ground, alternate tiers and chock tier ends.

B. All pipe and other materials subject to ultraviolet or ozone attack shall be protected from the sunlight, atmosphere and weather and stored in suitable enclosures until ready for installation.

C. Store all hydrants, valves and other materials off the ground, drained and kept free of water to protect against damage from freezing.

PART 2 PRODUCTS

2.01 DUCTILE IRON WATER MAIN

A. Design standard: AWWA C151

B. Thickness: AWWA C150, Class 52

C. Exterior coating: Bituminous, AWWA C151

D. Interior coating: AWWA C104

E. Joints: AWWA C111

F. Pipe marking:
   1. All pipe shall be marked as required by AWWA C151.
   2. All pipe shall be stamped to indicate compliance with NSF Standard 61.

2.02 PVC WATER MAIN

A. Design standard: AWWA C900

B. Pressure rating: 150 psi

C. Thickness: DR18

D. Joints: ASTM D3139 and AWWA C900.

E. Pipe marking:
   1. All pipe shall be marked as required by AWWA C900-07.
   2. All pipe shall be stamped to indicate compliance with NSF Standard 14 (NSF-pw).
   3. If the Contractor demonstrates that the pipe manufacturers cannot produce pipe in compliance with NSF-pw, then, with the concurrence of the Engineer, pipe stamped with NSF Standard 61 may be substituted. The use of any PVC pipe for water main that does not meet NSF Standard 14 for potable water shall also require the pre-approval of MDEQ-Water Bureau.

2.03 HDPE (High Density Polyethylene) WATER MAIN

A. Type: DR-11, ASTM 3350 for PE 3408, AWWA C906, Ductile Iron Pipe O.D.

B. Fittings: HDPE adapter provided by pipe manufacturer.

C. Pipe marking: All pipe shall be stamped to indicate compliance with NSF Standard pw.

D. HDPE pipe shall meet the requirements of MDEQ Water Division “Policy and Procedure DWRP-03-009”.

2.04 FITTINGS

A. Material: Cast Iron, Class 250 or Ductile Iron, Class 350

B. Design standards: AWWA C110, C153

C. Exterior coating: Bituminous, AWWA C151, 518.1

D. Interior coating: AWWA C104

E. Joints: AWWA C111, Mechanical Joint

2.05 RESTRAINED JOINTS

A. Ductile iron pipe:
   1. Push-on joint:
      a. Design standard: AWWA C111
      b. Thickness: AWWA C151, Class 52
      c. Manufacturers:
         i. Clow: SuperLock
         ii. U.S. Pipe: TR FLEX
   2. Mechanical joint:
      a. Retainer gland safety factor: 2:1
      b. Design requirement: Twist-off nuts to assure actuating restraint
      c. Manufacturers:
         i. EBAA Iron: MEGALUG, Series 1100
         ii. Standard International
   3. Ball joint:
      a. Design standard: AWWA C151
      b. Thickness: AWWA C150, Class 54
      c Exterior coating: Bituminous, AWWA C151, 518.1
      d. Interior coating: AWWA C104
      e. Joints: AWWA C110
      f. Manufacturers:
         i. U.S. Pipe: USIFLEX Pipe
         ii. Clow: Ball and Socket Pipe

B. PVC pipe:
   1. Design standard: UNIB13, AWWA C900 and AWWA C605.
   2. Gland design standard: ASTM A536
   3. Retainer gland safety factor: 2:1
   4. Design requirement: Twist-off nuts to assure actuating restraint
   5. Manufacturers:
      a. EBAA Iron: MEGALUG, Series 1100

2.06 GATE VALVE AND BOX

A. Gate valves:
   1. Design standard: AWWA C509, Resilient Wedge
   2. Opening: Counterclockwise
   3. Nonrising stem with 2" square operating nut
   4. Joint: AWWA C111, mechanical joint
   5. Interior coating: AWWA C550
   6. Exterior coating: AWWA C151, 518.1

B. Box:
   1. Cast iron three-piece screw type, adjustable box
   2. Cover marked "WATER"
   3. Shaft: 5¼” internal diameter

2.07 HYDRANTS- NOT USED

2.08 SERVICES

A. Tapping saddles:
   1. Materials: ASTM B62 Brass
   2. Type: Double Strap
   3. Manufactured and tested: AWWA C800
   4. Threads: AWWA taper thread

B. Corporation stops:
   1. Design standard: AWWA C800
   2. Type: Mueller H15000
   3. Flared copper outlet

C. Service lines:
   1. Material: ASTM B88, Type K Copper or engineer approved equal
   2. Joints: Flared or Compression

D. Curb stops:
   1. Design standard: AWWA C800
   2. Type: Mueller H15204
   3. Joints: Flared Copper

E. Curb box:
   1. ¾" to 1" Services
      a. Cast iron three-piece
      b. Mueller H10316
      c. Stationary rod
      d. Depth: 6 foot
   2. 1½" to 2" Services
      a. Cast iron three-piece
      b. Mueller H10336
      c. Stationary rod
      d. Depth: 6 foot

2.09 TAPPING SLEEVES & VALVES

A. Tapping valve:
   1. Design standard: AWWA C509
   2. Opening: Counter Clockwise.
   3. Non-Rising stem with a 2" square operating nut.
   4. Joint: AWWA C111, Mechanical Joint.
   5. Interior coating: AWWA C550
   6. Exterior coating: AWWA C151, 5181

B. Tapping sleeve:
   1. Joint:
      a. AWWA C111, Mechanical Joint.
      b. MSS SP60 Machined Face Joint to Tapping Valve.
   2. Cast or ductile iron
   3. Threaded and plugged port for pressure testing
   4. Coatings: As specified in paragraph 2.03.

2.10 DETECTABLE UNDERGROUND MARKING TAPE

A. Minimum width of 3 inches.

B. Blue colored detectable metallic tape bearing a legend similar to "Caution Buried Waterline Below."

2.11 TRACER WIRE

A All PVC or HDPE piping shall be installed with a continuous, insulated TW, THW, THWN, or HMWPE insulated copper, 10 gauge or thicker wire for pipeline location purposes by means

of an electronic line tracer.
1. The wires must be installed along the entire length of the pipe.
2. Sections of wire shall be spliced together using approved splice caps and waterproof seals. Twisting the wires together is not acceptable.

PART 3 EXECUTION

3.01 WATER MAIN INSTALLATION

A. Install pipe in accordance with the pipe manufacturer's recommendations including:
1. Unibell PVC Pipe Association.
2. Ductile Iron Pipe Research Association.
3. AWWA C600, "Installation of Ductile Iron Water Mains and Their Appurtenances."
4. AWWA C605, "Underground Installation of PVC Pressure Pipe and Fittings for Water Main."
5. AWWA C906, “Polyethyene Pressure Pipe for Water Distribution and Transmission.”

B. Alignment and Grade:
1. Lay pipe to the lines and grades established on the plans or as indicated by Engineer's stakes.
2. Maintain a 10' horizontal separation from sewer main.
3. Maintain an 18 inch minimum vertical separation from all utility crossings.
4. When crossing storm or sanitary sewer, locate the water main above the sewer crossing. If the minimum cover depth cannot be met, locate the water main below the sewer crossing and position the water main section centered on the sewer.

C. Earthwork:
Perform all trench excavation, pipe bedding, and backfilling in accordance with Section 31 00 00 EARTHWORK.

D. Pipe laying:
1. Provide a minimum depth of cover, from the top of the pipe to the proposed finish grade of 6 feet, unless noted otherwise on the plans.
2. Center the pipe within the trench with adequate clearance between the pipe and the trench sidewalls.
3. Each section of pipe shall rest upon the pipe bed for the full length of its barrel, with recesses excavated to accommodate the joints.
4. Thoroughly clean all foreign matter from the pipe and keep the pipe clean during the pipe laying operations by using temporary plugs.
5. Pipe shall not be installed in trenches containing water or mud without the approval of the Engineer.
6. All pipe ends shall be plugged with a watertight plug when construction stops for an extended period of time or overnight.
7. Prevent plugged pipe from floating.
8. Damage to linings and coatings shall be cause for rejection of the complete section of pipe.
9. Place a detectable tape 24" above the top of the pipe.
10. Tracer wire:
    a. If PVC or HDPE piping is utilized, provide a tracer wire pipe location system approved by the Engineer along the water main to form a continuous conductor between access points.
    b. Contractor will not be paid for water main installed without a continuous conductor.

E. Jointing pipe:
1. Thoroughly clean & lubricate bell, spigot, and gaskets.
2. Only joint lubricates approved by the pipe manufacture will be permitted.

3. Align the pipe & force it "Home" without damaging the joint.
4. Conform to AWWA C600, AWWA C605, and AWWA C906, as applicable.

F. Joint restraint:
Install all manufactured restrained joints in conformance with the manufacturer's recommendations.
1. Provide adequate joint restraint at all tees, plugs, caps, hydrants, and bends deflecting 22½ degrees or more.
2. Manufactured restrained joints:
   a. Install only where indicated on the plans, in the specifications or where directed by the Engineer.
3. Tie rods:
   a. Install only where indicated on the plans, in the specifications or where directed by the Engineer.
   b. Install where adequate earth backing is not available.
4. Concrete thrust blocks:
   a. Size and shape: As shown on the plans.
   b. Placing pour concrete only after all connections have been made.
   c. Location: Thrust block shall extend from the fitting to the undisturbed earth of the trench wall. Keep block behind the bell of fitting and below the hydrant drain.
   d. Bracing: Support fittings and valves independently of the piping until the concrete has set.

G. Connecting to existing mains:
1. Provide special adapters, fittings, and pipe as required to mate the new water main with the existing water main.
2. Do not connect the existing water supply system until the new water main has been pressure tested, disinfected, and approved by the engineer.
3. When making the connection, swab all pipe fittings with a 4% chlorine solution.
4. Provide adequate notice to owner about connections or excavations near water mains.

H. Future connections:
1. Provide thrust blocking that can be easily removed in the future.

I. Electrical conductivity:
1. Provide electrical conductivity between all ductile iron pipe, fittings and joints with the following connectors.
   a. Brass wedges (three (3) minimum per joint)
   b. "ElectroBond" strip connectors
2. Connectors shall be capable of carrying 400 amperes for an extended period.
3. Provide sufficient connectors to insure conductivity through all pipe, fittings, valves, and appurtenances.

3.02 SETTING VALVES

A. Set and join valves as specified for pipe sections in paragraph 3.01.

B. Set and firmly support valve boxes over the valve. Set the box centered and plumb over the valve operating nut. Set the box lid flush with the proposed finish grade.

3.03 SETTING THE HYDRANTS

A. Location:
1. Locate as shown on the plans.

2. Set hydrant plumb to the finish grade.
3. Set pumper nozzle pointing towards the curb or road edge.
4. Set the hydrant height to elevations shown on plans. Use hydrant extensions as shown on plans.

B. Shut-off valve box:
1. Install shut off valve, piping, and fittings as specified in paragraph 3.02.

C. Restraints:
1. Anchor shut off valve to hydrant tee with tie rods.
2. Provide thrust block at hydrant base.
3. Prevent thrust block concrete from covering hydrant drain.

3.04 SERVICE CONNECTIONS

A. Tapping saddles:
1. PVC main: use on all service connections
2. Ductile iron main:
a. Services ¾ inch to 1 inch: Not required.
b. Services 1½ inch to 2 inch: Use double strap tapping saddles.
c. 3 inch and larger: Use inline tees for service connections.

B. Corporation stops:
Use a corporation stop for services 2 inches and smaller as specified on the plans.

C. Service line:
1. Services ¾ inch to 2 inch: Install type "K" copper tubing from corporation to curb stop.
2. Services 3 inch and larger: Install ductile iron pipe.

D. Curb stops:
1. Services ¾ inch to 2 inch: Set curb stop and box as shown on the plans.
a. Set curb box plumb over valve operating stem.
b. Adjust box lid to proposed finish grade.
2. Services 3 inch and Larger: Install standard gate valve with box.

E. Earthwork:
Perform all trench excavation, pipe bedding, and backfilling in accordance with Section 31 00 00 EARTHWORK.

F. Cleaning:
Flush all service connections until clean.

3.05 FLUSHING

A. General:
1. All water main shall be flushed to remove dirt and foreign matter prior to connection to the existing water supply system.
2. Water for flushing will be the sole responsibility of the Contractor.
3. Water for flushing shall be from a potable source approved by the Engineer and the Michigan Department of Environmental Quality Drinking Water Division.
4. If water is available from any existing system, the Contractor shall comply with any requirements from the agency that controls the existing water system.
5. All connections to existing water supplies shall be made with a backflow prevention device in accordance with State of Michigan Act 399 and all other applicable laws of the State of Michigan.

B. Method:
1. Flush water mains using a "poly pig" supplied by the Contractor.
2. Insert the "poly pig" into the main at a location and using a method approved by the Engineer.
3. Retrieve the "poly pig" at a temporary blowoff assembly constructed by the Contractor, at a location approved by the engineer.
4. Repeat the "poly pigging" until all foreign matter is removed.

3.06 PRESSURE TESTING

A. General:
1. All water main shall be tested.
2. Conduct all testing only while the engineer is present.
3. Notify Engineer at least 24 hours prior to testing.
4. All connections to existing water supplies shall be made with a backflow prevention device in accordance with State of Michigan Act 399 and all other applicable laws of the State of Michigan.
5. If any section of pipe fails to pass a test, the Contractor shall determine the source of the failure, repair it, and retest the section at no additional cost to the Owner.
6. The tests shall be repeated until satisfactory results are obtained.

B. Test preparation:
1. Maximum test section: 2000 feet or as approved by the Engineer.
2. Install temporary caps or pugs where necessary to test sections.
3. Brace and sufficiently backfill all parts of the pipeline to prevent movement of the pipe.
4. Water for testing shall be from a source approved by the engineer.
5. If water is available from any existing system, the contractor shall comply with any requirements from the agency that controls the existing water system.
6. Expel all air from the pipe prior to testing. If necessary to accomplish this, taps shall be made at the high points using corporation stops as specified in 2.07 B. No additional compensation will be made for taps of this type.
7. When hydrants are in the test section, test against the main valve in the hydrant.

C. Testing water main:
1. Testing equipment:
a. Low flow high pressure pump capable of producing 200 psi.
b. 0 to 200 psi gauge with minimum gradations of 10 psi.
c. Measuring device approved by the Engineer.
2. Test method:
a. Ductile Iron Pipe: AWWA C600
b. PVC Pipe: AWWA C605
c. HDPE Pipe: in accordance with the recommendations of Chapter 2 of the Plastic Pipe Institute's *Handbook of Polyethylene Pipe,* with considerations for pipe expansion as follows:
(1) Pressurize pipe to 150 psi
(2) Add sufficient volume of water each hour to maintain 150 psi pressure for a total of three hours.
(3) Begin two hour test
3. Test pressure: 150 psi, with not less than 125 psi at the highest point.

4. Test period: 2 Hours
5. Allowable leakage: Defined as the amount of water that must be supplied into the pipe to maintain the test pressure of 150 psi to within ±5 psi during the test period. Leakage shall not exceed the rates shown below:
   a. 4 inch pipe: 0.66 gallons per 2 hour per 1000 feet of pipe.
   b. 6 inch pipe: 0.99 gallons per 2 hour per 1000 feet of pipe.
   c. 8 inch pipe: 1.32 gallons per 2 hour per 1000 feet of pipe.
   d. 10 inch pipe: 1.66 gallons per 2 hour per 1000 feet of pipe.
   e. 12 inch pipe: 1.99 gallons per 2 hour per 1000 feet of pipe.
6. Repair all visible leakage regardless of the amount.

D. Testing valves:
1. Test all valves in the closed position.
2. Apply a net test pressure of 125 psi for a period of 10 minutes.
3. A valve will be considered to have passed if after 10 minutes the pressure is within ±2 psi of the net test pressure, and in the opinion of the Engineer, no appreciable amount of leakage takes place during the test period.

3.07 DISINFECTION

A. General:
1. All water main shall be disinfected.
2. All sampling must be done while the Engineer is present.
3. Notify Engineer at least 24 hours prior to testing.
4. Unless authorized by the Engineer, disinfect water main after pressure testing.
5. Conduct disinfection in accordance with AWWA C651, unless modified by these specifications.

B. Disinfection procedure:
1. PolyPig and flush all water mains prior to disinfection.
2. Utilize the AWWA continuous feed method.
3. Inject the chlorine solution into the water main through a corporation stop installed at the opposite end of the discharge end of the main.
4. Fill the water main with the water and chlorine solution to produce a minimum concentration of 25 parts per million at the discharge end.
5. Valve off the water main and allow it to sit for a period of 24 hours. After 24 hours the chlorine residual shall be at least 10 mg/l.
6. Dispose of heavily chlorinated water in accordance with applicable regulations.
7. If there is any possibility that the chlorinated discharge will cause damage to the environment, the contractor shall neutralize the discharge water in accordance with AWWA C651 Appendix B.

C. Bacteriological testing:
1. Acceptable bacteriological tests must be obtained prior to connecting the new water main to the existing water distribution system.
2. Collect samples from the water main at locations designated by the Engineer. As a minimum, collect samples at the inlet, mid section and discharge end of the water main.
3. Collect samples from corporation stops. Samples from fire hydrants will not be allowed.
4. Submit samples to a laboratory approved by the Michigan Department of Environmental Quality Drinking Water Division and the Engineer for bacteriological analysis.
5. The pipe section will have passed after two consecutive samples, taken at 24 hour intervals, shows an absence of coliform, atypical, or overgrowth organisms. Acceptable sample results are negative for bacteria and as otherwise defined by AWWA C651 and MDEQ regulations
6. The Engineer may, at his discretion, collect samples for bacteriological testing.

7. Submit all test and laboratory results to the Engineer.
8. If sample fails, repeat disinfection and sample as required at no cost to the owner.

3.08 ELECTRICAL CONDUCTIVITY TESTING

A. Ductile iron pipe:
   1. General:
      a. All water main shall be tested.
      b. Conduct all testing only while a representative of the Owner is present.c. Notify Owner at least 24 hours prior to testing.
      d. If any section of pipe fails to pass a test, the Contractor shall determine the source of the failure, repair it, and retest the section.
      e. The tests shall be repeated until satisfactory results are obtained.
   2. Method:
      a. Test all water main and hydrants for electrical continuity.
      b. Conduct test after pressure testing and while the pipe is at normal operating pressure.
      c. Test the water main in section lengths approved by the Owner.
      d. Apply a direct current of 400 amps ± 10% through the test section for a period of 5 minutes.
      e. Measure current flow through the pipe continuously on a suitable ammeter. The current shall remain steady without interruption or excessive fluctuation.
      f. The pipe section will have failed if it shows signs of insufficient current, intermediate current, or arcing, indicated by large fluctuations of the ammeter.

B. PVC and HDPE pipe:
   1. Contractor shall demonstrate that the wire is continuous and unbroken through the entire run of the pipe.
      a. Demonstration shall include full signal conductivity (including splices) when energizing for the entire run in the presence of the Owner or Engineer.
      b. If the wire is broken, the Contractor shall repair or replace it. Pipeline installation will not be accepted until the wire passes a continuity test.

END OF SECTION

SECTION 33 31 13

SITE SANITARY SEWERAGE GRAVITY PIPING

PART 1 GENERAL

1.01 SUMMARY

A Section includes: all labor, materials, tools, and equipment necessary for the installation of all sanitary sewer piping, manholes, services, and appurtenances.

B. Related sections:
1. Section 01 20 00 - PRICE AND PAYMENT PROCEDURE
2. Section 01 33 00 - SUBMITTAL PROCEDURES
3. Section 31 00 00 - EARTHWORK

1.02 UNIT PRICES

Refer to Section 01 20 00 - PRICE AND PAYMENT PROCEDURE

1.03 REFERENCED STANDARDS

Unless otherwise specified, the work for this Section shall conform to the applicable portions of the following Standard Specification:

ASTM - American Society for Testing and Materials

1.04 SUBMITTALS

Submit complete sets of shop drawings and product data to the Engineer for review and approval, prior to ordering any material in accordance with Section 01300 Submittals.

PART 2 PRODUCTS

2.01 SANITARY SEWER MAIN

A. PVC sewer main and fittings:
1. Design standard: ASTM - D 3034.
2. Wall thickness: SDR-35.
3. Joints: Push on joint with elastomeric gasket meeting ASTM - D 3212.

2.02 SANITARY SERVICE PIPE

A. PVC sewer service pipe and fittings:
1. Design standard: ASTM - D 3034.
2. Wall thickness: SDR-35.
3. Joints: Push on joint with elastomeric gasket meeting ASTM - D 3212.

2.03 4 FOOT DIAMETER MANHOLES

A. Sections:
1. 4 foot diameter, precast section conforming to ASTM C-478.
2. Rubber gasket joints conforming to ASTM C-443.
3. Bottom slab and walls shall be cast integrally.

4. Top section:
   a. manholes less than 4 feet deep: flat top.
   b. manholes greater than 4 feet deep: eccentric cone.
5. Manhole to pipe connections: Kor-N-Seal neoprene boot with stainless steel bands.

B. Castings: East Jordan Iron Works #1040 with Type A cover.

C. Steps:
1. Steel reinforced polypropylene
2. 12” minimum width
3. Meet requirements of ASTM C-478, ASTM D-4104, ASTM A-615, and AASHTO No. M-199-811
4. Manufacturer - MA Industries, Inc. or American Step Co.

PART 3 EXECUTION

3.01 GRAVITY PIPE INSTALLATION

A. Earthwork: Perform all trench excavation, pipe bedding, and backfilling in accordance with Section 31 00 00 - Earthwork.

B. Line and grade controls:
1. Install PVC pipe according to ASTM D2321.
2. Lay all pipe in a straight line between manholes and structures.
3. Maintain grade by the use of laser beam.
4. Establish line and grade control from benchmarks and site coordinate lines.
5. Promptly report any alignment conflicts to the Engineer.

C. Pipe laying:
1. Each section of pipe shall rest upon the pipe bed for the full length of the pipe barrel.
2. Recess bedding to accommodate joints.
3. Maintain pipe and joints in a clean condition.
4. Provide concrete pipe anchors at all joints of pipe laid at slopes greater than 15 percent.
5. Lay pipe from downstream end to upstream end.

3.02 SEWER SERVICE LEADS

A. General:
1. Place 6 inch service leads from service wyes to property line or as indicated on the plans.
2. Provide minimum depth of cover of 6 feet within roadway.
3. Install a watertight plug in the end of each lead.
4. Install cleanouts at bends and maximum spacing of 100'.

B. Earthwork: Perform all trench excavation, pipe bedding, and backfilling in accordance with Section 31 00 00 - Earthwork.

C. Pipe laying:
1. Lay all pipe in a straight line between bends and structures.
2. Maintain grade using a method approved by the Engineer.
3. Install service leads where indicated on the plans.
4. Maintain pipe and joints in a clean condition.

D. Marker post:

1. Install a pressure treated 4" x 4" x 8' marker post at the end of each service lead.
2. Set bottom of marker post plumb and level with the service lead invert.
3. Cut the post to 24 inches above finished grade after the Engineer has recorded the elevation of the marker post top.
4. Paint the exposed marker post:
   a. Color: brown.

3.03 MANHOLES

A. Installation:
1. Construct base, sections, top cone, and castings in accordance with the detail shown on the Plans.
2. Place manhole base on 4 inches sand or aggregate leveling base.
3. Compact sand base to 95% Modified Proctor density by mechanical means.
4. Set manhole base and sections plumb.
5. Install rubber gasket between each manhole section and lubricate according to the manufacturers specifications.
6. Exterior coating: Petroleum based asphaltic coating.
7. Place approved backfill material around manhole in layers not exceeding 12 inches.
8. Compact each backfill layer by mechanical means to 95% Modified Proctor density.
9. Seal all joints and lift holes with non-shrink grout.

B. Flow Channel
1. Construct concrete flow channel as shown on the plans for each manhole.

3.04 TESTING

A. General:
1. All gravity main piping shall be subject to air (leakage) testing, deflection testing, and television inspection prior to acceptance by the Owner.
2. Conduct all testing only while the Engineer is present.
3. Notify the Engineer at least 24 hours prior to testing.
4. If any section of pipe fails to pass a test, the Contractor shall repair and retest the section at no additional cost to the Owner.
5. The tests shall be repeated until satisfactory results are obtained.
6. No connections shall be made on new pipe until all tests have passed.

B. Air testing:
1. Perform low pressure air test according to ASTM F1417.
2. Test each section of pipe from manhole to manhole or structure to structure.
3. A pipe section shall be considered as failed if the leakage exceeds the amount allowed by ASTM F 1417. (See Tables I and II at the end of this section of the specifications).
4. Initial pressure of 4 psi greater than the average back pressure of the groundwater above the pipe shall be maintained for 2 minutes to equalize air temperature.

C. Deflection testing:
1. Perform deflection testing no earlier than 30 days after final backfill has been placed.
2. Maximum allowable deflection is 5% as determined by ASTM D3034.
3. Perform testing by pulling a properly sized "go, no-go" mandrel between manholes.
4. Failure to pass the mandrel will indicate an unacceptable deflection, requiring re-excavation and replacement of the failed section at no additional cost to the Owner.
5. Repeat the test until satisfactory results are obtained.

D. Television inspection:
1. Conduct test with closed circuit television.
2. Record inspection on DVD.

3. Provide the Engineer with one copy of the inspection video recording within 15 days of televising.
4. The recorded inspection shall include audio or visual aids which indicate the exact location of the video camera.
5. All defects in the sewer shall be noted during the inspection.
6. Provide written log of all observations.
7. Repair all defects at no cost to the Owner and re-televise until satisfactory results are obtained.

3.05 CLEANING

A. Clean the sewer and manholes to the satisfaction of the Engineer, before testing.

B. Cleaning shall be done with high pressure water jetting equipment. Equipment shall be approved by the Owner.

C. Remove any debris from the sewer or manholes that was dislodged by cleaning.

D. Clean all manhole flow channels and steps to the satisfaction of the Engineer.

3.06 REMOVE EXISTING MANHOLES
NOT USED

3.07 CONNECT TO EXISTING LAGOON

A. General:
1. Use a coring machine to cut hole in existing manhole.
2. Install a sleeve per plans.

END OF SECTION

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TABLE 1

MINIMUM SPECIFIED TIME REQUIRED FOR A 1.0 PSIG PRESSURE DROP FOR SIZE AND LENGTH OF PIPE INDICATED FOR Q = 0.0015

1 Pipe Diameter (in.)	2 Minimum Time (min: sec)	3 Length for Minimum Time (ft)	4 Time for Longer Length (sec)	Specification Time for Length (L) Shown (min:sec)								
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft
4	3:46	597	.380 L	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	398	.854 L	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24
8	7:34	298	1.520 L	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24
10	9:26	239	2.374 L	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48
12	11:20	199	3.418 L	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38
15	14:10	159	5.342 L	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04
18	17:00	133	7.692 L	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41
21	19:50	114	10.470 L	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31
24	22:40	99	13.674 L	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33
27	25:30	88	17.306 L	28:51	43:16	57:41	72:07	86:32	100:57	115:22	129:48
30	28:20	80	21.366 L	35:37	53:25	71:13	89:02	106:50	124:38	142:26	160:15
33	31:10	72	25.852 L	43:05	64:38	86:10	107:43	129:16	150:43	172:21	193:53
36	34:00	66	30.768 L	51:17	76:55	102:34	128:12	153:50	179:29	205:07	230:46
42	39:48	57	41.883 L	69:48	104:42	139:37	174:30	209:24	244:19	279:13	314:07
48	45:34	50	54.705 L	91:10	136:45	182:21	227:55	273:31	319:06	364:42	410:17
54	51:02	44	69.236 L	115:24	173:05	230:47	288:29	346:11	403:53	461:34	519:16
60	56:40	40	85.476 L	142:28	213:41	284:55	356:09	427:23	498:37	569:50	641:04

Note: If there has been no leakage (zero psig drop) after one hour of testing, the test section shall be accepted and the test complete. (See Section 7.5.)

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TABLE II

MINIMUM SPECIFIED TIME REQUIRED FOR A 0.5 PSIG PRESSURE DROP FOR SIZE AND LENGTH OF PIPE INDICATED FOR Q = 0.0015

1 Pipe Diameter (in.)	2 Minimum Time (min: sec)	3 Length for Minimum Time (ft)	4 Time for Longer Length (sec)	Specification Time for Length (L) Shown (min:sec)								
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft	
4	1:53	597	.190 L	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:53	
6	2:50	398	.427 L	2:50	2:50	2:50	2:50	2:50	2:50	2:51	3:12	
8	3:47	298	.760 L	3:47	3:47	3:47	3:47	3:48	4:26	5:04	5:42	
10	4:43	239	1.187 L	4:43	4:43	4:43	4:57	5:56	6:55	7:54	8:54	
12	5:40	199	1.709 L	5:40	5:40	5:42	7:08	8:33	9:58	11:24	12:50	
15	7:05	159	2.671 L	7:05	7:05	8:54	11:08	13:21	15:35	17:48	20:02	
18	8:30	133	3.846 L	8:30	9:37	12:49	16:01	19:14	22:26	25:38	28:51	
21	9:55	114	5.235 L	9:55	13:05	17:27	21:49	26:11	30:32	34:54	39:16	
24	11:20	99	6.837 L	11:24	17:57	22:48	28:30	34:11	39:53	45:35	51:17	
27	12:45	88	8.653 L	14:25	21:38	28:51	36:04	43:16	50:30	57:42	64:54	
30	14:10	80	10.683 L	17:48	26:43	35:37	44:31	53:25	62:19	71:13	80:07	
33	15:35	72	12.926 L	21:33	32:19	43:56	53:52	64:38	75:24	86:10	96:57	
36	17:00	66	15.384 L	25:39	38:28	51:17	64:06	76:55	89:44	102:34	115:23	
42	19:54	57	20.942 L	34:54	52:21	69:49	87:15	104:42	122:10	139:37	157:04	
48	22:47	50	27.352 L	45:35	68:23	91:11	113:58	136:46	159:33	182:21	205:09	
54	25:31	44	34.618 L	57:42	86:33	115:24	144:15	173:05	201:56	230:47	259:38	
60	28:20	40	42.738 L	71:14	106:51	142:28	178:05	213:41	249:18	284:55	320:32	

Note: If there has been no leakage (zero psig drop) after one hour of testing, the test section shall be accepted and the test complete. (See Section 7.5.)

SECTION 33 31 23

SANITARY SEWERAGE FORCE MAIN PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

Provide all labor, tools, equipment, and testing necessary for the installation of all force main and appurtenances and related sections.

1.02 RELATED SECTIONS

Section 01 20 00 - PRICE AND PAYMENT PROCEDURE
Section 31 00 00 - EARTHWORK

1.03 UNIT PRICES

Refer to Section 01 20 00 - PRICE AND PAYMENT PROCEDURE

1.04 REFERENCED STANDARDS

Unless otherwise specified, the work for this Section shall conform to the applicable portions of the following Standard Specification:

ANSI - American National Standards Institute
ASTM - American Society for Testing and Materials
AWWA - American Water Works Association
NSF - National Sanitation Foundation

1.05 SUBMITTALS

Submit complete sets of shop drawings and product data to the ENGINEER for review and approval, prior to ordering any material.

1.06 DELIVERY, STORAGE AND HANDLING

A. Piping shall not be stacked higher than four feet. Suitable racks, chairs and other supports shall be provided to protect pipe mating surfaces from damage. Store bottom tiers off the ground, alternate tiers and chock tier ends.

B. All pipe and other materials subject to ultraviolet or ozone attack shall be protected from the sunlight, atmosphere and weather and stored in suitable enclosures until ready for installation.

C. Store all valves and other materials off the ground, drained and kept free of water to protect against damage from freezing.

PART 2 PRODUCTS

2.01 DUCTILE IRON FORCE MAIN

A. Pipe material:
1. Above ground ANSI A21.50/A21.51, Class 53, AWWA C-151.
2. Below ground ANSI A21.50/A21/51, Class 52, AWWA C-151.
3. Asphaltic exterior lining, cement mortar interior lining in accordance with ANSI A21.4, AWWA C-104.

2.02 PVC FORCE MAIN

A. Pipe material:
1. Option 1 - Polyvinyl Chloride (PVC), Class 200, SDR21, ASTM D-2241 with elastomeric gasket push on joint.
Option 2 – PVC, SCH-80, meeting ASTM D-1785 or PVC, SDR26, ASTM D-2241 with elastomeric gasket push on joint.
2. For potable water lines, pipe must be NSF approved; CPVC to eye showers if a local code requirement.

B. Fittings:
1. PVC injection molded IPS fittings.
a. Pressure rating equal to or greater than pipe option selected.
b. Meets ASTM D-2241, ASTM D-3139 (joints), and ASTM D-1784 (classification 12454B).
2. Mechanical joint ductile iron fittings as described in 2.01c above (with transition gaskets for Option 1 or 3).

C. Restrained joints:
1. Uniflange 1300, 1350 or 13990 restrainers.
2. EBBA Iron Sales, Inc., Series 2000PV, 1100HV, 1500, and/or 6500, MJ Field Lok PV as required, or Engineer approved equal.

2.03 HDPE (High Density Polyethylene) FORCE MAIN

A. Type: DR-17, ASTM 3350 for PE 3408, AWWA C906

B. Fittings: HDPE adapter provided by pipe manufacturer.

2.04 RESTRAINED JOINTS

A. Ductile iron pipe:
1. Push-on joint:
a. Design standard: AWWA C111
b. Thickness: AWWA C151, Class 52
c. Manufacturers:
i. Clow: Super-Lock
ii. U.S. Pipe: TR FLEX
iii. American: Fast-Grip
2. Mechanical joint:
a. Retainer Gland Safety Factor: 2:1
b. Design requirement: Twist-off nuts to assure actuating restraint
c. Manufacturers:
i. EBAA Iron: MEGALUG, Series 1100
ii. Standard International
3. Ball joint:
a. Design standard: AWWA C151
b. Thickness: AWWA C150, Class 54
c. Exterior coating: Bituminous, AWWA C151, 51-8.1
d. Interior coating: AWWA C104
e. Joints: AWWA C110
f. Manufacturers:
i. U.S. Pipe: USIFLEX Pipe
ii. Clow: Ball and Socket Pipe

B. PVC pipe:
   1. Design standard: UNI-B-13
   2. Gland design standard: ASTM A536
   3. Retainer gland safety factor: 2:1
   4. Design requirement: Twist-off nuts to assure actuating restraint
   5. Manufacturers: EBAA Iron: MEGALUG, Series 2000 PV

2.06 GATE VALVE AND BOX

A. Gate valves:
   1. Design standard: AWWA C509, Resilient Wedge
   2. Opening: Counter-clockwise
   3. Non-rising stem with 2" square operating nut
   4. Joint: AWWA C111, mechanical joint
   5. Interior coating: AWWA C550
   6. Exterior coating: AWWA C550

B. Box:
   1. Cast iron three piece screw type, adjustable box
   2. Cover marked "SEWER"
   3. Shaft: 5 1/4" internal diameter

2.07 SEWAGE AIR RELEASE AND VACUUM VALVE

A. Body and cover: Cast Iron, ASTM A126 Gr.B

B. Internal linkage, stem: Stainless Steel, Series T300

C. Float: Stainless Steel, ASTM A240 T304

D. Needle: Buna-N, Nitrile Rubber

E. Exterior paint: Phenolic Primer Red Oxide

F. Manufacturers:
   1. Apco/Valve & Primer Corporation Model 400 WA with back flushing accessories
   2. Clow 5404 AF with back flushing accessories

2.08 DETECTABLE UNDERGROUND MARKING TAPE

A. Minimum width of 3 inches.

B. Brown colored detectable metallic tape bearing a legend similar to "Caution - Buried Pipeline Below".

2.09 TRACER WIRE

A All PVC or HDPE piping shall be installed with a continuous, insulated TW, THW, THWN, or HMWPE insulated copper, 10 gauge or thicker wire for pipeline location purposes by means of an electronic line tracer.
   1. The wires must be installed along the entire length of the pipe.
   2. Sections of wire shall be spliced together using approved splice caps and waterproof seals. Twisting the wires together is not acceptable.

PART 3 EXECUTION

3.01 FORCE MAIN INSTALLATION

A. Install pipe in accordance with the pipe manufacturer's recommendations including:
   1. Unibell PVC Pipe Association.
   2. Ductile Iron Pipe Research Association.
   3. AWWA C600, "Installation of Ductile Iron Water Mains and Their Appurtenances."
   4. AWWA C605, "Underground Installation of PVC Pressure Pipe and Fittings for Water Main."
   5. AWWA C906, “Polyethylene Pressure Pipe for Water Distribution and Transmission.”

B. Alignment and grade:
   1. Lay pipe to the lines and grades established on the plans.
   2. Maintain a 10' horizontal separation from water main.
   3. Maintain an 18 inch minimum vertical separation from all utility crossings.
   4. When crossing water main, locate the force main below the water main. When the minimum separation cannot be met, locate the force main below the water main and position the force main section centered on the water main. Encase crossing in concrete.

C. Earthwork:
   Perform all trench excavation, pipe bedding and backfilling in accordance with Section 31 00 00 - Earthwork.

D. Pipe laying:
   1. Provide a minimum depth of cover, from the top of the pipe to the proposed finish grade, of 6 feet, unless noted otherwise on the plans.
   2. Center the pipe within the trench with adequate clearance between the pipe and the trench sidewalls.
   3. Each section of pipe shall rest upon the pipe bed for the full length of its barrel, with recesses excavated to accommodate the joints.
   4. Thoroughly clean all foreign matter from the pipe and keep the pipe clean during the pipe laying operations by using temporary plugs.
   5. Pipe shall not be installed in trenches containing water or mud without the approval of the Engineer.
   6. All pipe ends shall be plugged with a water tight plug when construction stops for an extended period of time or overnight.
   7. Prevent plugged pipe from floating.
   8. Damage to linings and coatings shall be cause for rejection of the complete section of pipe.
   9. Place a detectable tape 24" above the top of pipe.
   10. Tracer wire:
      a. If PVC or HDPE piping is utilized, provide a tracer wire pipe location system approved by the Engineer along the water main to form a continuous conductor between access points.
      b. Contractor will not be paid for water main installed without a continuous conductor.

E. Joining pipe:
   1. Thoroughly clean & lubricate bell, spigot, and gaskets.
   2. Only joint lubricants approved by the pipe manufacture will be permitted.
   3. Align the pipe and push "Home" without damaging the joint.
   4. Conform to AWWA C600.

F. Joint restraint:
   1. Install all manufactured restrained joints in conformance with the manufacturer's recommendations.
   2. Provide adequate joint restraint at all tees, plugs, caps, reducers, and bends deflecting 22½° or more.
   3. Install only where indicated on the plans, in the specifications or where directed by the Engineer.
   4. Tie rods:

a. Install only where indicated on the plans, in the specifications or where directed by the Engineer.
b. Install where adequate earth backing is not available.

5. Concrete thrust blocks:
   a. Size and Shape: As shown on the plans.
   b. Placing: Pour concrete only after all connections have been made.
   c. Location: Thrust block shall extend from the fitting to the undisturbed earth of the trench wall. Keep block behind the bell of fitting.
   d. Bracing: Support fittings and valves independently of the piping until the concrete has set.

G. Electrical conductivity:
1. Provide electrical conductivity between all ductile iron pipe, fittings and joints with the following connectors.
   a. Brass wedges (three (3) minimum per joint)
   b. "ElectroBond" strip connectors
2. Connectors shall be capable of carrying 400 amperes for an extended period.
3. Provide sufficient connectors to insure conductivity through all pipe, fittings, valves, and appurtenances.

3.02 SETTING VALVES

A. Set and join valves as specified for pipe sections in paragraph 3.01.

B. Set and firmly support valve boxes over the valve. Set the box centered and plumb over the valve operating nut. Set the box lid flush with the proposed finish grade.

3.03 FLUSHING

A. General:
1. All force main shall be flushed to remove dirt and foreign matter prior to connection to the existing sewer system.
2. Water for flushing will be the sole responsibility of the Contractor.
3. Water for flushing shall be from a source approved by the Engineer and the Michigan Department of Environmental Quality Drinking Water Division.
4. If water is available from any existing potable water system, the Contractor shall comply with any requirements from the agency that controls the existing water system.
5. All connections to existing water supplies shall be made with a Michigan Department of Environmental Quality approved backflow prevention device.

B. Method:
1. Flush force mains using a “poly-pig” supplied by the Contractor.
2. Insert the “poly-pig” into the main at a location and using a method approved by the Engineer.
3. Retrieve the “poly-pig” at a temporary blow-off assembly constructed by the Contractor, at a location approved by the engineer.
4. Repeat the “poly- pigging” until all foreign matter is removed.

3.04 PRESSURE TESTING

A. General:
1. All force mains shall be tested.
2. Conduct all testing only while the engineer is present.
3. Notify Engineer at least 24 hours prior to testing.
4. All connections to existing potable water supplies shall be made with a backflow prevention device in accordance with State of Michigan Act 399 and all other applicable

laws of the State of Michigan.

5. If any section of pipe fails to pass a test, the Contractor shall determine the source of the failure, repair it, and retest the section at no additional cost to the Owner.
6. The tests shall be repeated until satisfactory results are obtained.

B. Test preparation:
   1. Maximum test section: 2000 feet or as approved by the Engineer.
   2. Install temporary caps or pugs where necessary to test sections.
   3. Brace and sufficiently backfill all parts of the pipeline to prevent movement of the pipe.
   4. Water for testing shall be from a source approved by the engineer.
   5. If water is available from any existing system, the contractor shall comply with any requirements from the agency that controls the existing water system.
   6. Expel all air from the pipe prior to testing. If necessary to accomplish this, taps shall be made at the high points using corporation stops approved by the Engineer. No additional compensation will be made for taps of this type.

C. Testing force main:
   1. Testing equipment:
      a. Low flow-high pressure pump capable of producing 200 psi.
      b. 0 to 200 psi gauge with minimum gradations of 10 psi.
      c. Volume measuring device approved by the Engineer.
   2. Test method:
      a. Ductile Iron Pipe: AWWA C600
      b. PVC Pipe: AWWA C605
      c. HDPE Pipe: in accordance with the recommendations of Chapter 2 of the Plastic Pipe Institute's *Handbook of Polyethylene Pipe,* with considerations for pipe expansion as follows:
         (1) Pressurize pipe to 150 psi
         (2) Add sufficient volume of water each hour to maintain 150 psi pressure for a total of three hours.
         (3) Begin two hour test
   3. Test pressure: 150 psi, with not less than 125 psi at the highest point.
   4. Test period: 2 Hours
   5. Allowable leakage: Defined as the amount of water that must be supplied into the pipe to maintain the test pressure of 150 psi to within ±5 psi during the test period. Leakage shall not exceed the rates shown below:
      a. 2 inch pipe: 0.36 gallons per 2 hour per 1000 feet of pipe.
      b. 3 inch pipe: 0.55 gallons per 2 hour per 1000 feet of pipe.
      c. 4 inch pipe: 0.66 gallons per 2 hour per 1000 feet of pipe.
      d. 6 inch pipe: 0.99 gallons per 2 hour per 1000 feet of pipe.
      e. 8 inch pipe: 1.32 gallons per 2 hour per 1000 feet of pipe.
      f. 10 inch pipe: 1.66 gallons per 2 hour per 1000 feet of pipe.
      g. 12 inch pipe: 1.99 gallons per 2 hour per 1000 feet of pipe.
   6. Repair all visible leakage regardless of the amount.

D. Testing valves:
   1. Test all valves in the closed position.
   2. Apply a net test pressure of 125 psi for a period of 10 minutes.
   3. A valve will be considered to have passed if after 10 minutes the pressure is within ±2 psi of the net test pressure, and in the opinion of the Engineer, no appreciable amount of leakage takes place during the test period.

3.05 ELECTRICAL CONDUCTIVITY TESTING

A. Ductile iron pipe:
   1. General:

a. All water main shall be tested.
b. Conduct all testing only while a representative of the Village is present.c. Notify Village at least 24 hours prior to testing.
d. If any section of pipe fails to pass a test, the Contractor shall determine the source of the failure, repair it, and retest the section.
e. The tests shall be repeated until satisfactory results are obtained.

2. Method:
a. Test all water main and hydrants for electrical continuity.
b. Conduct test after pressure testing and while the pipe is at normal operating pressure.
c. Test the water main in section lengths approved by the Village.
d. Apply a direct current of 400 amps ± 10% through the test section for a period of 5 minutes.
e. Measure current flow through the pipe continuously on a suitable ammeter. The current shall remain steady without interruption or excessive fluctuation.
f. The pipe section will have failed if it shows signs of insufficient current, intermediate current, or arcing, indicated by large fluctuations of the ammeter.

B. PVC and HDPE pipe:
1. Contractor shall demonstrate that the wire is continuous and unbroken through the entire run of the pipe.
a. Demonstration shall include full signal conductivity (including splices) when energizing for the entire run in the presence of the Owner or Engineer.
b. If the wire is broken, the Contractor shall repair or replace it. Pipeline installation will not be accepted until the wire passes a continuity test.

END OF SECTION

SECTION 40 05 59

HYDRAULIC GATES

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work included:
   1. Sluice Gates

1.02 DESIGN REQUIREMENTS

A. Chemical resistance: All gate components must be suitable for continuous contact with normal municipal wastewater.

B. Strength: All gates shall be sufficiently strong to resist the maximum pressure head with water at the top of the sidewall in which the gate is installed.

1.03 QUALITY ASSURANCE

A. Manufacturer's qualifications:
   1. All gates shall be the product of a manufacturer having a minimum of 10 years experience of successful design and manufacture of low leakage slide gates under similar design conditions.
   2. Upon request, provide evidence of ten installations in satisfactory operation.
   3. All welds shall be performed by welders with AWS certification.

B. Reference standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified:
   1. ASTM A276, stainless steel and heat-resisting steel bars and shapes.
   2. ASTM B209, aluminum sheet and plate.
   3. ASTM B221 and B308, aluminum alloy and sand castings for general application.
   4. ASTM B584, copper alloy and sand castings for general application.
   5. ASTM D4020, UHMW polyethylene molding and extrusion material.
   6. ASTM D2000, standard classification system for rubber products in automotive applications.
   7. ASTM B26, aluminum alloy sand castings.

1.04 SUBMITTALS

A. Make all submittals in accordance with Section 01 33 00 - SUBMITTAL PROCEDURES.

B. Submit shop drawings showing the following:
   1. Complete description in sufficient detail to permit item by item comparison with specifications.
   2. Dimensions and weights
   3. Capacity
   4. Maximum support reactions
   5. Performance characteristics
   6. Layout drawing for all equipment showing installation details.
   7. Deviations from plans and specifications.
   8. Manufacturer's installation and testing instructions.
   9. Affidavits of compliance with referenced standards and codes.

B. Submit written guarantee in accordance with the Contract Documents.

C. Submit manufacturer's literature describing the operation and maintenance of gates, including but not limited to the following:
   1. Operation Data:
      a. Complete, detailed operating instructions for each piece of equipment.
      b. Explanations of all safety considerations relating to operation.
   2. Maintenance Data:
      a. Include all information and instructions required to keep equipment properly lubricated and adjusted so that it functions economically throughout its full design life.
      b. Explanation with illustrations as necessary for each maintenance task.
      c. Recommended spare parts lists.
      d. Recommended schedule of maintenance tasks.
      e. Lubrication charts and table of alternate lubricants.
      f. Troubleshooting instructions.
      g. List of special maintenance tools and equipment.
      h. Name, address and phone number of manufacturer and manufacturer's local service.
      i. Copies of all approved Shop Drawings.

D. Submit manufacturer’s installation report.

1.05 DELIVERY, STORAGE AND HANDLING

A. Manufacturer shall issue written instructions to the Contractor on special handling and installation requirements.

B. Supply two extra copies of these instructions to the Engineer.

PART 2 – PRODUCTS

2.01 STOP GATES

A. General: Provide non-self contained stop gate as indicated on plans with slot grip.

B. Performance:
   1. Maximum allowable leakage 0.01 gallons per minute per foot of wetted perimeter regardless of direction of unbalanced head.

C. Manufacturer and model: Series 816 Aluminum Gates, as manufactured by Whipps, Inc., HG561 as manufactured by Hydro-Gate, or Engineer approved equal.

D. Frame:
   1. Manufactured from extruded aluminum, Alloy 6061-T6.
   2. Minimum thickness: ¼”
   3. Side guides shall incorporate ultra-high molecular weight polymer (UHMW) seat/seals on both the upstream and downstream sides of the slide.
   4. Guide and invert members shall have a minimum weight of 2.5 lb/ft.
   5. Invert member shall have a minimum weight of 3 lb/ft.
   6. Invert member shall contain a removable neoprene seal.
   7. Anchor bolts
:
      a. Assembly and anchor bolts shall be type 304 stainless steel.
      b. Minimum diameter ½”.
      c. Provided by gate manufacturer.
   8. Gates that cover submerged openings and weir gates shall have UHMW seat/seals on both sides and top of the gate opening, in addition to the neoprene invert seal.

E. Slide:
   1. Manufactured from extruded aluminum, Alloy 6061-T6.
   2. Minimum thickness: ¼”
   3. Slide shall be reinforced with stiffeners as required so that under maximum head the slide will not deflect more than 1/16” and flexure stress is limited to 7000 psi.
   4. Shear stress at welds shall be limited to 3000 psi.

PART 3 - EXECUTION

3.01 INSTALLATON

A. Install all equipment in strict accordance with the manufacturer's recommendations and Shop Drawings as approved by the Engineer.

END OF SECTION

SECTION 40 23 00

WATER AND WASTEWATER PROCESS PIPING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Provide all labor, materials, tools, and equipment necessary for the installation of all interior and above grade exterior process piping, including valves and appurtenances.

B. Work includes, but is not necessarily limited to:
1. Headworks Influent and Effluent piping
2. Effluent force mains
3. Low pressure compressed air lines
4.

1.02 RELATED WORK

A. Section 09 90 00 PAINTING
Section 10 14 00 SIGNS AND IDENTIFICATION DEVICES.

B. Division 23 – Heating Ventilation and Air Conditioning

1.03 SUBMITTALS

A. Product data:
Submit manufacturer's literature and test data demonstrating that materials comply with ASTM, ANSI, AWWA or other applicable standards.

B. Shop drawings:
Submit Shop Drawings of adapters between pipes and fittings of different materials.

C. Guarantees:
1 year guarantee for all valves.

PART 2 - PRODUCTS

2.01 PIPE AND FITTINGS

A. General:
1. All process piping to be PVC Sch 80 push-on joint unless otherwise specified or indicated in Drawings.
3. All non-potable water distribution lines located in the Headworks Addition Building shall be schedule 80 PVC.

B. Ductile iron pipe:
1. All pipe material shall conform to ANSI A21.50/A21.51, AWWA C-151, Class 53.
2. All pipe shall be cement lined, standard thickness, in accordance with ANSI A21.4, AWWA C-104.
3. All exposed pipe shall be coated, at the point of fabrication, on the outside with a universal rust-inhibitive primer 1.5 to 2.0 mils dry thickness.
4. Fittings:
a. Coated and lined as specified for pipe above.

b. For 12" diameter and smaller, cast iron Class 250 or ductile iron Class 350, ANSI A21.10, AWWA C-110 or AWWA C-153.
c. For 14" diameter and larger, 150 psi cast iron or 250 psi ductile iron.

5. Joints:
   a. Above ground pipe and fittings:
      1. Flanged: Class 125, ANSI B16.1/AWWA C-115.
      2. Grooved Couplings: AWWA C-606, Victaulic type.
   b. Below ground structures:
      1. Mechanical joint typical
      2. Restrained joint: Clow F-1058, mechanical joint with retainer gland.
      3. Grooved Couplings: AWWA C-606, Victaulic type.
   c. Provide special ends where required to connect to structures, valves, pipe or couplings of other manufacturer's.
6. Gaskets:
   a. Provide full faced flanged tight gaskets compatible with installed flanges meeting the appropriate ANSI/AWWA/ASME Standard.

C. Steel pipe:
1. In accordance with Materials Specifications in AWWA C200. Spirally welded steel pipe will not be allowed.
2. Fabricated and hydrostatically tested in accordance with AWWA C200.
3. Fittings: Fabricated in accordance with AWWA C208.
4. Pipe sections shall be connected by flanges or mechanical couplings.
   a. Mechanical couplings:
      1. Dresser Style 38; or equal.
      2. Joints: Harnessed in accordance with AWWA design manual M-11 to withstand the testing pressure.
      3. 24" and smaller: Minimum 1/4" x 7" middle ring.
      4. Larger than 24": Minimum 3/8" x 10" middle ring.
   b. Grooved end pipe couplings:
      1. Victaulic Style 77; or equal for cut or roll grooved pipe:
      2. Victaulic Style 07; or equal for steel pipe up to and including 12" diameter and 14" to 24" diameter.
      3. Grooved end pipe couplings larger than 24" diameter: Victaulic Style 41 with Type C pipe ends; or equal.
   c. All steel pipe flanges shall be AWWA L-207, Class D, Table 1.
5. Steel pipe: Lined with coal-tar epoxy protective coatings in accordance with AWWAC210.
6. Minimum steel pipe wall thicknesses shall be 0.250 inches.

D. Polyvinyl chloride pipe (PVC):
1. Materials:
   a. All PVC pipe, valves, and fittings: Manufactured from material which meets the requirements of Type 1, Grade 1 Polyvinyl chloride as outlined in ASTM D-1785.
   b. Design stress rating: Min. 210 PSI for temp. use of 140°F (max) for water service.
   c. All materials from which pipe, valves and fittings are manufactured must be tested and approved for conveying sewage.
   d. Marked: ASTM D1785 with pipe size, material designation code, pipe schedule and pressure rating @ 73°F and D1785 designation.
2. Fittings:
   a. Socket type fittings: ASTM D-2467.
   b. Threaded type fittings: ASTM D-2464.
3. Installation:
   a. Installation procedures, including support spacing, solvent welding, and

allowance for expansion and contraction shall be in accordance with the manufacturer's recommendations.

2.02 SUPPORTS AND HANGERS

A. General:
1. Furnish factory fabricated hangers and supports complete with necessary inserts, clamps, bolts, nuts, washers, and accessories. See also Section 15140.
2. Design, layout, and spacing of the pipe supports shall be the responsibility of the Contractor.

B. Manufacturers and types:
1. Pipe hangers: Clevis or split ring type with adjustable threaded hanger rods.
2. Hangers and supports: Grinnell, Unistrut, Crane, or equal.

2.03 WALL SLEEVES

A. General:
1. The same material as the pipe, or standard weight steel pipe thimbles of at least one size larger than the pipe itself.
2. Iron pipe wall castings, wall pipe, transition sleeves and solid sleeves:
   a. AWWA Specifications C100
   b. Lightest class conforming to the pressure rating of the pipelines which they connect, but in no case shall be lighter than Class B.
3. Wall sleeves shall be schedule 40 steel pipe of suitable size for installation of casing seal having bolted links of size and number compatible with piping size.
4. Seal shall be modular mechanical type consisting of chemical resistant interlocking synthetic rubber links shaped to continuously fill the annular space between pipe and wall opening.
5. The rubber seals shall be expanded by tightening stainless steel bolts, with a pressure plate under each bolt head.
6. Upon expansion the seal assembly shall provide an absolutely watertight seal between pipe and wall.

B. Manufacturers and types:
Modular mechanical seal shall be "Link-Seal" by Thunderline Corporation, or equal.

2.04 VALVES

A. General:
1. Provide valves of the size and type as indicated on the Drawings and in these Specifications.
2. All valves of each type shall be the product of one manufacturer.
3. Valve joints shall match adjacent pipe. Generally, all valves with diameter of 3" and larger shall be flanged or grooved joints for above ground applications, and mechanical joints for underground applications.
4. All interior gate valves with a centerline above 5’-0” shall be operated by a bevel gear and chain wheel per this specification section; if the valve centerline is below this condition, then the valve shall be operated by a hand wheel with a bevel gear per this section.
5. All interior plug valves with a centerline above 5’-0” shall be operated by a lever and chain; if the valve centerline is below this condition, then the valve shall be operated by an operating nut with wrench per this section.

6. All interior ball valves with a centerline above 5’-0” shall be operated by a lever and chain; if the valve centerline is below this condition, then the valve shall be operated per this section.

B. Plug valves:
1. Shall be in full conformance with the latest revision of the AWWA C517 standard; proof shall be provided to the Engineer in shop drawings.
2. Shall be of the non-lubricated, quarter-turn, eccentric and round ported type.
3. Valve body and cover shall be ductile iron, ASTM Standard A536, with ANSI class 125 flanges. The interior and exterior of the body shall be epoxy-coated with two part epoxy (min. 6 mils).
4. Shall have plugs made of ductile iron, ASTM Standard A536, with a vulcanized synthetic rubber seat facing tested per ASTM D429.
5. Seats shall have body seats of 95% welded nickel applied directly to the body and machined to a smooth finish.
6. Shall have oil impregnated, permanently lubricated 316 S.S. radial shaft bearings. Shall have S.S. thrust bearings on the upper and lower plug shaft. Shall have grit seals on the upper and lower bearing journals.
7. Valve shall provide bi-directional, tight shutoff in accordance with MSS SP-72.
8. The valves shall be rated for 175 psi.
9. Valve bodies shall be marked to indicate whether valve is open or closed.
10. Provide totally enclosed, heavy-duty chain wheel, nut, or lever operators, as required, with corrosion resistant bearings on all eccentric plug valves.
11. Plug valves shall GA Industries Figure 517 ECO-Centric Plug Valves or engineer approved equal.

C. Gate valves:
1. All gate valves 3" or larger in size shall be resilient-seated gate valves meeting requirements of ANSI/AWWA C509.
2. Gate valves shall be designed for 250 psi working pressure.
3. Generally, end connections shall be flanged or grooved for all inside valves and mechanical joint for all exterior ground buried valves.
4. Gate valves shall be ductile cast iron body, fully bronze mounted, bronze stem, o-ring stem seal, non-rising stem.
5. Gate valves shall have a clear waterway equivalent in area, when open, equal to that of the connecting pipe.
6. Valves shall be made to open when turned to the left, or counterclockwise, the direction being indicated by an arrow cast into the valve.
7. Valves shall be the product of one of the following manufacturers, or equal: Clow, US Pipe, Mueller or ACIPCO.

D. Cushion Swing check valves:
1. The valve shall have a heavy duty body shall be constructed of high-strength cast iron conforming to ASTM A126 Class B with integral flanges, faced and drilled per ANSI B16.1 Class 125 and be suitable for horizontal or vertical installation.
2. The valve body shall be the full waterway type, designed to provide a net flow area not less than the nominal inlet pipe size when swung open no more than 25 degrees. The valve shall have a replaceable 316 stainless steel body seat.
3. Valve disc shall be cast iron and faced with a renewable resilient seat ring of rubber or other suitable material, held in place by a follower ring and stainless steel screws.
4. The disc arm shall be ductile iron or steel, suspended from and keyed to an austenitic stainless steel shaft which is completely above the waterway and supported at each end by heavy bronze bushings. The shaft shall rotate freely

without the need for external lubrication. The shaft shall be sealed where it passes through the body by means of a stuffing box and adjustable packing. Simple O-ring shaft seals are not acceptable.

5. The valve shall be supplied with an outside lever and spring. The valve shall be made to operate without slam. Commercial air cylinders which pivot and/or are attached with fabricated brackets are not acceptable.
6. The check valve shall be GA Industries, Inc. Figure 230 Lever and Spring or approved equal.

E. Ball valves:
1. Provide ball valves with straight through flow to minimize turbulence and pressure loss.
2. Valve body and cover shall be ductile iron, ASTM Standard A126, with ANSI class 125 flanges. The interior and exterior of the body shall be epoxy-coated.
3. Provide PTFE infused stainless steel ball with a 304 stainless steel stem blowout-proof stem.
4. Provide PTFE seats and seals. The stem seal shall be PTFE, externally adjustable chevron type.
5. Provide 2" operating nut with adjustable/removable handle as space it tight.
6. Valve shall provide bi-directional, tight shutoff in accordance with MSS SP-72.
7. The valves shall be rated for 150 psi.
8. Valve bodies shall be marked to indicate whether valve is open or closed.
9. All ball valves shall be designed to operate drip free with a pressure of 50 psi on both sides or either side of the valve.
10. Ball valves shall be American, Series 4000; or engineer approved equal.

F. Air Release Valve:
1. Shall be GA Industries, Fig. #939F, Short Body Sewage Air/Vacuum Valve or approved equal.
2. Shall have a 2" NPT inlet, ½" outlet and $^{3}/_{16}$" Orifice and flushing attachments and accessories.
3. The 2" inlet piping from manifold to isolation valve and between isolation valve to air release valve shall be stainless steel NPT. The 2" isolation ball valve shall be stainless steel.

G. Electric Actuators:
1. Shall be Rotork IQT Part-turn Electric Actuator or approved equal.
2. Shall be single phase with a direct torque output range from 50-2,000 N/m.
3. Emergency handwheel, watertight & hazardous area enclosures, user interface with display, compatible with owner's control system.

H. Valve boxes:
1. Install valve boxes over all underground valves.
2. Valve boxes shall extend to finish grade.
3. Install valve boxes plumb and concentric with the valve stem.
4. Provide extended nuts to 6" of finished grade for valves deeper than five feet.
5. Valve boxes shall be three-piece, screw type boxes, Flow F-2450; or equal.

I. Operators:
1. Valve operators shall be of the type as necessary for the application as approved by the Engineer.
2. Valve operators shall be designed to hold the valve in any intermediate position between fully open and fully closed without creeping or fluttering.
3. Chain wheel:
   a. Chain wheel shall be equipped with chain guides.

b. Chains shall be rust-proofed.
c. Chain wheel shall be mounted directly on handwheel and shall be approximately the same diameter.
d. Chain wheels shall be Clow F-5680; or equal.

4. Handwheel:
   a. Made of fabricated steel or cast iron.
   b. Key to operating nut.
5. Lever:
   a. Lever shall be fabricated steel.
   b. Shall include a set screw and be grease lubricated.
6. Infinite lever: Infinite lever shall be of extra heavy steel and capable to be moved to any position and locked in place by a simple wing nut.
7. Position lever: Position lever shall be of extra heavy steel with a multiple position throttling plate.
8. Wrench head:
   a. Wrench heads shall be cast iron with set screw.
   b. They shall be furnished for all wrench nuts except where extension stems or T-handle wrenches are required.
9. Wrench nut:
   a. Wrench nuts shall be provided with a 2-inch operating nut when a T-handle wrench or extension stem is required.
   b. All other wrench nuts shall be furnished with a wrench head.
10. Provide two two-inch square tee wrenches six-feet long.
11. Provide two (2) pipe extensions at 1'-6" long and two (2) pipe extensions at 2'-6" long for the wrench head operators provided.

J. Ball check valves (Surge Tank Effluent Pumps):
1. Provide a non-mechanical, positive seating ball check valve.
2. Manufacturer: GA Industries, Inc, or approved equal.
3. Model: Figure 240.
4. Materials:
   a. Body: Cast iron meeting ASTM A-126-B
   b. Ball: Vulcanized Buna-N rubber cover over cast iron ASTM A-126-B
   c. Temperature Rating: 150 F
5. End connections: Flanged, ANSI 125#.
6. Pressure rating: 150 psi.

2.05 BOLTS

Use stainless steel bolts on all joints and fittings that will be submerged in wastewater or sludge.

2.06 FLOOR DRAIN

Neenah #R-4953-B Cast iron floor drain with grate, or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General:
1. Install all process piping and accessories in strict accordance with the manufacturer's recommendations as approved by the Engineer and as indicated on the Drawings.
2. Install items to be embedded before concrete is placed.
3. Fasten embedded items securely to prevent movement when concrete is placed.

4. Install items true to lines, grades, elevations, and locations as indicated on the Drawings and herein specified.

B. Hangers and supports:
1. Install hangers and supports at less than maximum spacing as recommended by pipe manufacturer.
2. Adjust hangers and supports to bring pipe lines to proper elevations.
3. Inserts installed in concrete shall be flush with the concrete surface and capable of developing the full strength of the bolt.

C. Wall sleeves:
1. Unless otherwise shown on the Drawings, at all points where pipes and duct must pass through walls, floors or roofs of structures, the Contractor shall furnish and install suitable sleeves or wall castings.
2. Unless otherwise shown or permitted, the space between the pipe and the sleeve shall be sealed at the inside and outside wall faces on walls exposed to earth or water/sewage, at one face of other walls, and at the top surface of floors and slabs.
3. After pipes have been placed through wall sleeves, clean the space between the pipe and the wall sleeve and install seal in accordance with the manufacturer's recommendations.

D. Pipes and fittings:
1. Install pipe and fittings with mechanical joints for underground locations and pipe and fittings with flanged or grooved joints in all other locations except as otherwise specified or indicated on the Drawings.
2. All piping and fittings under structures shall have mechanical joint retainer glands or be otherwise fully restrained. Encase in concrete as called for on the plans.
3. Pressure test all lines under structures before the pipe line becomes inaccessible.
4. Provide spare spool pieces at all meter locations.

E. Thrust blocks:
1. Place thrust blocks on underground pressure piping at all bends and angles in the piping.
2. Thrust blocks shall extend from the fitting to undisturbed side or end of trench.
3. Pipe and fittings shall be left accessible unless otherwise specified.
4. If undisturbed earth is not available for thrust blocking, provide fully restrained joints at least two pipe lengths either side of all bends.

F. Valves:
1. Refer to individual valve specifications in Part 2 above for special installation requirements on individual valves.
2. Check and adjust valves, operators and accessories for smooth operation.
3. Valve stem guides, supports, and extensions shall be furnished as required to provide convenient and positive valve operation.

3.02 TESTING

A. General:
1. All pressure pipe shall be subject to pressure testing.
2. All gravity piping shall be subject to air (leakage) testing and visual lamping for alignment.
3. Conduct all testing only while the Engineer is present.
4. Notify the Engineer at least 24 hours prior to testing.
5. If any section of pipe fails to pass a test, the Contractor shall determine the source of the failure, repair them, and retest the section at no additional cost to the Owner.

6. The tests shall be repeated until satisfactory results are obtained.

B. Pressure testing:
1. Test ductile iron pipe in accordance with AWWA C600.
2. Test PVC pipe in accordance with AWWA C605.
3. Test sections shall not exceed 1000 feet.
4. Expel all air from the pipe section and pump water into the pipe to achieve the test pressure.
5. Test pressure: 150 psi
6. Test period: 1 hour.
7. Leakage shall be defined as the quantity of water, measured by a method approved by the Engineer, that must be supplied to the pipe to maintain the test pressure to within +/- 5 psi during the test period.
8. Maximum allowable leakage is defined as follows for ductile iron pipe

   L = (S x D x (P)^1/2)/133,200

   L = leakage in gallons per hour
   S = length of pipe in feet
   D = pipe diameter in inches
   P = test pressure in pounds per square inch
9. Maximum allowable leakage is defined as follows for PVC pipe

   L = (N x D x (P)^1/2)/7400

   L = leakage in gallons per hour
   N = total number of joints
   D = pipe diameter in inches
   P = test pressure in pounds per square inch
10. If leakage exceeds the allowable amount, The Contractor shall repair the leak until the leakage is reduced to an allowable rate.
11. All visible leaks shall be repaired regardless of the amount of leakage.

C. Air testing:
1. Perform low pressure air test in accordance with ASTM F1417.
2. Test each section of pipe from manhole to manhole or structure to structure.
3. A pipe section shall be considered as failed if the leakage exceeds the amount allowed in the ASTM standard.
4. Initial pressure of 4 psi greater than the average back pressure of the groundwater above the pipe shall be maintained for 2 minutes to equalize air temperature.
5. Pressure drop: Measure time interval for pressure to drop from 3.5 psi to 3.0 psi.

3.03 PAINTING

Paint all pipe, fittings, supports, hangers, and accessories in accordance with Section 09 90 00 PAINTING and Section 10 14 00 - SIGNS AND IDENTIFICATION DEVICES.

END OF SECTION

SECTION 40 70 00

INSTRUMENTATION FOR PROCESS SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work included:
1. Furnish and install a gas detection and alarm system in the headworks buildings as herein specified
2. Furnish and install control equipment and instrumentation.
3. Include all components necessary to achieve the functional intent indicated on the Drawings and in these Specifications.
4. Control system integration based on functional intent

B. Basic equipment and services:
1. Flow meters.
2. Instrumentation panels.
3. Alarm system.
4. Actuated Valves.
5. Control system integration.

C. Related Sections:

Section 01 33 00 - SUBMITTAL PROCEDURES
Section 40 20 00 – WATER AND WASTEWATER PROCESS PIPING
Section 43 20 00- PROCESS PUMPS
Section 46 21 00 - SCREEENING EQUIPMENT
All pertinent sections of Division 26 - Electrical.

1.02 SYSTEM DESCRIPTION

A. Alarms:
1. The system shall include local visual alarm.
2. Each alarm shall have two adjustable alarm level relays and a system fault relay.
3. Alarms shall be preset and factory calibrated prior to shipment.

B. Mechanical screen unit:
1. Controlled with a manufacturer provided remote control panel and a local panel
2. Operating on a timed interval and/or a float system (with float backup).
3. Control panel and accessories: as specified in 46 21 00 – SCREENING EQUIPMENT.
4. Control system to be furnished and installed by contractor per manufacturer's recommendation.

C. Process Pump Unit
1. Controlled with a manufacturer provided remote control panel and a local panel
2. Operating on a timed interval and/or a float system (with float backup).
3. Control panel and accessories: as specified in 46 21 00 – SCREENING EQUIPMENT.
4. Control system to be furnished and installed by contractor per manufacturer's recommendation.

1.03 QUALITY ASSURANCE

A. Field:
1. For installation of the work of this section, use only personnel completely trained and experienced in installation of the materials and equipment, and thoroughly familiar with the original design and approved Shop Drawings.

2. The manufacturer shall supply proof of five similar units in successful operation. This information shall be submitted along with shop drawings and shall include but not be limited to the following:
   a. Name and location of installation.
   b. Name of person in direct responsible charge for the equipment.
   c. Address and phone number of person in direct responsible charge.
   d. Month and year the equipment was placed in operation.
   e. Brief description of equipment.

1.04 SUBMITTALS

A. General:
1. Make all submittals in accordance with Section 01 33 00 - SUBMITTAL PROCEDURES.

B. Shop drawings:
1. Submit Shop Drawings showing dimensions and details of construction and installation.

C. O & M manuals:
1. Submit operation and maintenance manuals for the equipment.

D. Guarantee:
1. Submit written guarantee in accordance with the contract documents.

E. Manufacturer's literature:
1. Submit manufacturer's literature describing the operation of the system.

PART 2 - PRODUCTS

2.01 SELECTOR SWITCHES

A. General:
1. Provide selector switches for the control panels as indicated on the Drawings and herein specified.
2. Oil-tight type designed for panel mounting.
3. Rated at 6 amps on 120 Vac.

2.02 AUTOMATIC VALVES

1. Electrically Actuated Valves: Rotork IQT Part-turn Electric Actuator or Approved Equal
2. Flanged connections unless otherwise noted on the plans.
3. Valve body and seat:
   Cast Iron, Ductile Iron or Carbon Steel and TFM seat, full port
4. Actuator: B7 Series, NEMA 4X, 2 conduit entry ports, visual position indictor, manual override
5. 115 volt Ac actuated, unless otherwise noted.
6. Rated for continuous duty cycle, and fail in the shut position.
7. Shall be single phase with a direct torque output range from 50-2,000 N/m

8. Emergency handwheel, watertight & hazardous area enclosures, user interface with display. Compatible with owner's control system.

2.03 CONTROL PANELS

A. The following is a list of control panels:
   1. Panels provided by the manufacturer with the equipment specified:
      a. CP-1: Automatic Screen Panel
      b. CP-2: Pump Panel
      c. CP-3: Gas Detection Panel
      d. CP-4: Air Infusion Panel
   2. Panels fabricated by the Contractor:
      a. None

2.04 FUNCTIONAL INTENT

SCREEN LAYOUT – POSSIBLE ADDS

1. Main Screen – Overall Process
   a. Total Influent Flow (FE 01)
   b. Total Surge Tank Effluent Flow (FE 01 – LE10)
   c. Total Surge Tank Volume (LE 10)
2. Lift Stations
   a. HOA control (HS 11-15)
   b. Run Status (KIR 11-15)
   c. Individual Influent flow (FE 21-26)
   d. Total Influent Flow
3. Surge Tank
   a. Level
      1. Indicate and calculated volume (LIT 33)
      2. Operator set point for high and low level alarm
      3. Operator set point for "maintain level"
      4. Level controls service pump speed (M-34, M-35)

      ii. Low water float (LE 32)

      iii. High water float (LE 33)

      iv. Surge Tank Service Pumps

         1. Pumps Running (KIR 34 - 35)

            a. Elapsed run time meter

2. HOA (HS 34 -35)
3. Operator Speed set point
4. Speed indicate (SI 34 -35)
5. Valve position indicate (ZI 50 -54)

v. Discharge Flow (FE 37 - 38)

1. Flow indicate (FI 37 -38)
2. Totalized Flow (FQ 37 – 38)
3. Select which meter is active (one is redundant)

4. Effluent Pump Systems

a. Final Effluent Tanks (1 and 2)

i. Level

1. Indicate level and calculated volume (LIT 63, LIT 67)
2. Operator set point for high and low level alarm

ii. Low water float (LE 62, LE 68)

iii. High water float (LE 61, LE 64)

b. Effluent Pumps

i. Pump 1 Running (KIR 66)

ii. HOA (HS 66)

iii. Operator Speed set point

iv. Speed indicate (SI 66)

v. Pump 2 Running (KIR 67)

vi. HOA (HS 67)

vii. Operator Speed set point

viii. Speed indicate (SI 67)

ix. Discharge Flow (FE 39)

x. Flow Indicate (FI 39)

xi. Totalized Flow (gallons per load) (FQ 39)(batch program A=3,500; B=10,500; C= 11,500; D= Operator Input)

5. Alarms

a. Display all indicated alarms

b. Dialer call out on: (need to confirm)

i. General lift station low flow alarm

ii. Surge Tank high level alarm

iii. Power failure

iv. Emergency generator running

v. Effluent Tank (1 or 2) high level alarm

vi. Effluent Tank (1 or 2) low level alarm

vii. Day Tank High Level

viii. pH greater than 11

6. Trend Graph

a. All I/O available

ALARM AND PROCESS LOGIC

1. Initiate system shutdown sequence

a. EP pumps off, sequential with 5 second time delay each

b. Surge Tank Pumps off (M34, M35) at low level

c. Chemical Feed Pumps off once Surge Tank Pumps turn off (M81, M82)

- All other processes can work until low level in tank have been exhausted and chemical tanks have been topped off (Day Tank) or exhausted (Bulk Tank).

2. EP Pump Stations

a. Low flow alarm for each pump

b. High flow alarm for each pump

c. On/off via Level Transducer, Each Station

d. Elapsed run time meter for each pump

e. Total Influent flow, low flow alarm

f. Total Daily Flow, each station

3. Pump Systems

*The final effluent tanks are adjacent to each other and interconnected by manual valves: a 6-inch overflow and an 8-inch at the bottom of the tanks to operate them together or separately. The tanks can be operated in three different scenarios, of which, all are entirely possible depending on flows into the plant and maintenance scheduling. The following are the three- (3) scenarios: (1) The valve

interconnects are both open and the tanks are filled from either surge tank pump and are pumped down from either effluent pump in either tank; (2) The 6-inch interconnect is the only valve open and the effluent is pumped into either tank and out of a particular tank with the overflow only being utilized as an emergency; (3) Both valve interconnects are closed and the effluent is pumped into and out of one tank.

SCENARIO 1

a. Surge Tank Pumps

i. Low level alarm, pumps off

ii. Alternate pump operation, each shutdown or daily, 1st occurrence

iii. Pump start at operator set "maintain" level

iv. Pump stop at operator set "off" level

v. High level alarm, initiate system shutdown

a. Time delay (operator adjustable)

b. High level operator adjustable

vi. PUMP #1 Running: M-50, M-51 and M-53 OR M-54 normally opened (depends which tank the operator wants to fill)(other valves closed)

vii. PUMP #2 Running: M-49, M-52 and M-53 OR M-54 normally opened (depends which tank the operator wants to fill)(other valves closed)

viii. All automated valves to maintain position in fail mode

ix. Effluent Tanks 1 AND 2 Level status high; Initiate system shutdown

b. Final Effluent Discharge Pumps

i. Low level alarm, pump off

ii. Fail to start alarm

iii. Pump start at operator batch request; verify volume of water in tank; Pump volume of operator's request (A, B, C or D)

iv. Speed control by operator set point

v. High level alarm each tank, indicate

vi. High-High alarm, check each tank level status; check all valves status, initiate system shutdown sequence if both tanks full

SCENARIO 2

c. Surge Tank Pumps

x. Low level alarm, pumps off

xi. Alternate pump operation, each shutdown or daily, 1st occurrence

xii. Pump start at operator set “maintain” level

xiii. Pump stop at operator set “off” level

xiv. High level alarm, initiate system shutdown

a. Time delay (operator adjustable)

b. High level operator adjustable

xv. PUMP #1 Running: M-50, M-51 and M-53 OR M-54 normally opened (depends which tank the operator wants to fill)(other valves closed)

xvi. PUMP #2 Running: M-49, M-52 and M-53 OR M-54 normally opened (depends which tank the operator wants to fill)(other valves closed)

xvii. All automated valves to maintain position in fail mode

xviii. Effluent Tanks 1 AND 2 Level status high; Initiate system shutdown

d. Final Effluent Discharge Pumps

vii. Low level alarm, pump off

viii. Fail to start alarm

ix. Pump start at operator batch request; verify volume of water in tank; Pump volume of operator’s request (A, B, C or D)

x. Speed control by operator set point

xi. High level alarm each tank, indicate

xii. High-High alarm, check each tank level status; check all valves status, initiate system shutdown sequence if both tanks full

SCENARIO 3

e. Surge Tank Pumps

xix. Low level alarm, pumps off

xx. Alternate pump operation, each shutdown or daily, 1st occurrence

xxi. Pump start at operator set “maintain” level

xxii. Pump stop at operator set “off” level

xxiii. High level alarm, initiate system shutdown

a. Time delay (operator adjustable)

b. High level operator adjustable

xxiv. PUMP #1 Running: M-50, M-51 and M-53 OR M-54 normally opened (depends which tank the operator wants to fill)(other valves closed)

xxv. PUMP #2 Running: M-49, M-52 and M-53 OR M-54 normally opened (depends which tank the operator wants to fill)(other valves closed)

xxvi. All automated valves to maintain position in fail mode

xxvii. Effluent Tanks 1 OR 2 Level status high; Initiate system shutdown

f. Final Effluent Discharge Pumps

xiii. Low level alarm, pump off

xiv. Fail to start alarm

xv. Pump start at operator batch request; verify volume of water in tank; Pump volume of operator's request (A, B, C or D)

xvi. Speed control by operator set point

xvii. High level alarm tank 1 OR 2 (whichever is in use), indicate

xviii. High-High alarm, check each tank level status; check all valves status, initiate system shutdown sequence if tank is full and other tank is still not available

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install all process control equipment in strict accordance with the manufacturer's recommendations as approved by the Engineer, as indicated on the Drawings, and as herein specified.

B. Electrical work: In accordance with Division 26 - ELECTRICAL.

C. Provide, fabricate and install any required mounting brackets and devices as required.

D. Instrumentation and control devices: Install, wire, calibrate and successfully test operate after installation.

3.02 FIELD TESTING

A. With the help of a representative of the manufacturer, the Contractor shall thoroughly field test the system prior to turning the system over to the Owner. Start up services shall include: training session for plant operator covering use, setting of alarm thresholds, calibration, and routine service and trouble shooting.

B. General:
1. Control panels: Completely assembled and factory tested prior to shipment.
2. Any defects detected at this time shall be corrected in the factory.
3. Field installation:
   a. Set the panel in place
   b. Make the necessary electrical and piping connections
   c. Test all functions of the panels.

3.03 CHECK OUT

A. As soon as practical after installation, the instrumentation and controls supplier's engineer shall:
   1. Check out the work of this Section.
   2. Promptly make all changes and additions as required for the approval.

3.04 INSTRUCTIONS

When all required approvals of this portion of the work have been obtained, and at a time designated by the Owner, the supplier's engineer shall thoroughly demonstrate to the wastewater treatment plant personnel the operation and maintenance of all items installed under the work of this Section and demonstrate the contents of the manual submitted under Article 1.02 of this Section.

3.05 CLEANING

Prior to acceptance of the work of this Section, thoroughly clean all installed materials, equipment and related areas.

3.03 ELECTRICAL WORK

A. All electrical work shall be performed as indicated on the drawings and as specified in Division 26, Electrical, and elsewhere in this section.

END OF SECTION

SECTION 43 20 00

PROCESS PUMPS AND ACCESSORIES

PART 1 - GENERAL

1.01 Section Includes

A. Work under this section includes, but is not limited to, furnishing and installing a factory built duplex pump station as indicated on the project drawings, herein specified, as necessary for proper and complete performance.

1.02 References

A. Publications listed below form part of this specification to extent referenced in the text by basic designation only. Consult latest edition of publication unless otherwise noted.

1. American National Std. Institute (ANSI) / American Water Works Assoc. (AWWA)
   a. ANSI B16.1 Cast iron pipe flanges and flanged fittings.
   b. ANSI/AWWA C115/A21.51 Cast/ductile iron pipe with threaded flanges.
   c. ANSI 253.1 Safety Color Code for Marking Physical Hazards.
   d. ANSI B40.1 Gages, Pressure and Vacuum.
   e. AWWA C508 Single Swing Check Valves.

2. American Society for Testing and Materials (ASTM)
   a. ASTM A48 Gray Iron Castings.
   b. ASTM A126 Valves, Flanges, and Pipe Fittings.
   c. ASTM A307 Carbon Steel Bolts and Studs.
   d. ASTM A36 Structural Steel.

3. Institute of Electrical and Electronics Engineers (IEEE)
   a. ANSI/IEEE Std 100 Standard Dictionary of Electrical Terms.
   b. ANSI/IEEE Std 112 Test Procedure for Polyphase Induction Motors.
   c. IEEE Std 242 Protection of Industrial and Control Power Systems.

4. National Electric Code (NEC) / National Electrical Manufacturers Assoc. (NEMA)
   a. NEC National Electric Code.
   b. NEC 701 National Electric Code article 701.
   c. NEMA Std MG1 Motors and Generators.

5. Miscellaneous References
   a. Ten-State Standards Recommended Standards for Sewage Works.
   b. Hydraulic Institute Std for Centrifugal, Rotary and Reciprocating Pumps.
   c. NMTBA and JIC Std National Machine Tool Builders Association and Joint Industrial Council Standards
   d. ISO 9001 International Organization for Standardization.

1.03 System Description

A. Contractor shall furnish and install one factory built base mounted, automatic pump station. The station shall be complete with all equipment specified herein, factory assembled on a common steel base.
B. Principal items of equipment shall include two horizontal, self priming, centrifugal sewage pumps, V-belt drives, motors, piping, valves, motor control panel, automatic liquid level control system, and integral wiring.

C. Factory built pump station design, including materials of construction, pump features, valves and piping, and motor controls shall be in accordance with requirements listed under PART 2 - PRODUCTS of this section.

1.04 Performance Criteria

A. The pump manufacturer must be ISO 9001 revision certified, with scope of registration including design control and service after sales activities.

B. The pump manufacturer must be registered to the ISO 14001 Environmental Management System standard and as such is committed to minimizing the impact of its activities on the environment and promoting environmental sustainability by the use of best management practices, technological advances, promoting environmental awareness and continual improvement.

C. Pumps must be designed to handle raw, unscreened, domestic sanitary sewage. Pumps shall have 6" suction connection, and 6" discharge connection. Each pump shall be selected to perform under following operating conditions:

1. Pump Model T6A60S-B
2. Capacity (GPM) 500
3. Total Dynamic Head (FT) 37.5
4. Total Dynamic Suction Lift(FT) 15.2
5. Maximum Repriming Lift (FT) 18
6. Minimum TDH (FT) 26.4
7. Maximum TDH (FT) 37.5
8. Maximum Static Suction Lift (FT) 21
9. Total Discharge Static Head (FT) 18.3
10. Minimum Submergence Depth (FT) 2

D. Site power furnished to pump station shall be 3-phase, 60 hertz, 480 volts, 4 wire, maintained within industry standards. The available fault current provided at the pump station control panel is 60 kA rms symmetrical. Voltage tolerance shall be plus or minus 10 percent. Phase-to-phase unbalance shall not exceed 1% average voltage as set forth in NEMA Standard MG-1. Control voltage shall not exceed 132 volts.

1.05 Submittals

A. Product Data

1. Prior to fabrication, pump station manufacturer shall submit 2 copies of submittal data for review and approval.

2. Submittal shall include shop drawings, electrical ladder logic drawings, and support data as follows: Catalog cuts sheets reflecting characteristics for major items of equipment, materials of construction, major dimensions, motor and v-belt drive data, pump characteristic curves showing the design duty point capacity (GPM), head (FT), net positive suction head required (NPSHr), and hydraulic brake horsepower (BHP). Electrical components used in the motor branch and liquid level control shall be fully described.

B. Shop drawings shall provide layout of mechanical equipment and anchor bolt locations for station. Contractor piping connections and station access clearances shall be dimensioned relative to the station centerline. The electrical ladder logic drawings shall illustrate motor branch and liquid level control circuits to extent necessary to validate function and integration of circuits to form a complete working system.

C. Operations Maintenance Manuals

1. Installation shall be in accordance with written instructions provided by the pump station manufacturer. Comprehensive instructions supplied at time of shipment shall enable personnel to properly operate and maintain all equipment supplied. Content and instructions shall assume operating personnel are familiar with pumps, motors, piping and valves, but lack experience on exact equipment supplied.

2. Documentation shall be specific to the pump station supplied and collated in functional sections. Each section shall combine to form a complete system manual covering all aspects of equipment supplied by the station manufacturer. Support data for any equipment supplied by others, even if mounted or included in overall station design, shall be provided by those supplying the equipment. Instructions shall include the following as a minimum:

    a. Functional description of each major component, complete with operating instructions.

    b. Instructions for operating pumps and pump controls in all modes of operation.

    c. Calibration and adjustment of equipment for initial start-up, replacement of level control components, or as required for routine maintenance.

    d. Support data for commercially available components not produced by the station manufacturer, but supplied in accordance with the specifications, shall be supported by literature from the prime manufacturer and incorporated as appendices.

    e. Electrical schematic diagram of the pump station circuits shall be in accordance with NMTBA and JIC standards. Schematics shall illustrate, to the extent of authorized repair, pump motor branch, control and alarm system circuits including interconnections. Wire numbers and legend symbols shall be shown. Schematic diagrams for individual components, not normally repairable by the station operator, need not be included. Details for such parts shall not be substituted for an overall system schematic. Partial schematics, block diagrams, and simplified schematics shall not be provided in lieu of an overall system diagram.

    f. Mechanical layout drawing of the pump station and components, prepared in accordance with good commercial practice, shall provide installation dimensions and location of all pumps, motors, valves and piping.

3. Operation and maintenance instructions which rely on vendor cut-sheets and literature which include general configurations, or require operating personnel to selectively read portions of the manual shall not be acceptable. Operation and maintenance instructions must be specific to equipment supplied in accordance with these specifications.

1.06 Quality Assurance

A. The pumps and pump station manufacturer must be ISO 9001 certified, with scope of registration including design control and service after sales activities.

B. The pump station manufacturer must be registered to the ISO 14001 Environmental Management System standard and as such is committed to minimizing the impact of its activities on the environment and promoting environmental sustainability by the use of best management practices, technological advances, promoting environmental awareness and continual improvement.

C. Upon request from the engineer, the pump station manufacturer shall prove financial stability and ability to produce the station within the specified delivery schedules. Evidence of facilities, equipment and expertise shall demonstrate the manufacturer's commitment to long term customer service and product support.

D. Manufacturer must show proof of original product design and testing. Products violating intellectual property regulations shall not be allowed, as they may violate international law and expose the user or engineer to unintended liabilities. “Reverse-engineered” products fabricated to substantially duplicate the design of original product shall not be allowed, as they may contain substantial differences in tolerances and material applications addressed in the original design, which may contribute to product failure.

E. The term “pump manufacturer” or “pump station manufacturer” shall be defined as the entity which designs, machines, assembles, hydraulically tests and warranties the final product. Any entity that does not meet this definition will not be considered a “pump manufacturer” or “pump station manufacturer” and is not an acceptable supplier. For quality control reasons and future pump and parts availability, all major castings of the pump shall be sourced and machined in North America.

F. Pump Performance Certifications

1. Solids Handling Capability

a. All internal passages, impeller vanes, and recirculation ports shall pass a 3" spherical solid. Smaller internal passages that create a maintenance nuisance or interfere with priming and pump performance shall not be permitted. Upon request from the engineer, manufacturer’s certified drawings showing size and location of the recirculation port(s) shall be submitted for approval.

G. Reprime Performance

1. Consideration shall be given to the sanitary sewage service anticipated, in which debris is expected to lodge between the suction check valve and its seat, resulting in the loss of the pump suction leg, and siphoning of liquid from the pump casing to the approximate center line of the impeller. Such occurrence shall be considered normal, and the pump must be capable of automatic, unattended operation with an air release line installed.

2. During unattended operation, the pump shall retain adequate liquid in the casing to insure automatic repriming while operating at its rated speed in a completely open system. The need for a suction check valve or external priming device shall not be required.

3. Pump must reprime 10 vertical ft. at the specified speed and impeller diameter. Reprime lift is defined as the static height of the pump suction above the liquid, while operating with only one-half of the liquid remaining in the pump casing. The pump must reprime and deliver full capacity within five minutes after the pump is energized in the reprime condition. Reprime performance must be confirmed with the following test set-up:

a. A check valve to be installed down stream from the pump discharge flange. The check valve size shall be equal (or greater than) the pump discharge diameter.

b. A length of air release pipe shall be installed between pump and the discharge check valve. This line shall be open to atmosphere at all times duplicating the air displacement rate anticipated at a typical pump station fitted with an air release valve.

c. The pump suction check valve shall be removed. No restrictions in the pump or suction piping will prevent the siphon drop of the suction leg. Suction pipe configuration for reprime test shall incorporate a 2 feet minimum horizontal run, a 90 degree elbow and vertical run at the specified lift. Pipe size shall be equal to the pump suction diameter.

d. Impeller clearances shall be set as recommended in the pump service manual.

e. Repeatability of performance shall be demonstrated by testing five consecutive reprime cycles. Full pump capacity (flow) shall be achieved within five minutes during each cycle.

f. Liquid to be used for reprime test shall be water.

4. Upon request from the engineer, certified reprime performance test results, prepared by the manufacturer, and certified by a registered professional engineer, shall be submitted for approval prior to shipment.

H. Factory System Test

1. All components including the pumps, motors, valves, piping and controls will be tested as a complete working system at the manufacturer's facility. Tests shall be conducted in accordance with Hydraulic Institute Standards at the specified head, capacity, rated speed and horsepower. Factory operational test shall duplicate actual performance anticipated for the complete station.

2. Upon request from the engineer, the operational test may be witnessed by the engineer, and/or representatives of his choice, at the manufacturer’s facility.

I. The manufacturer’s technical representative shall inspect the completed installation, correct or supervise the correction of any defect or malfunction, and instruct operating personnel in the proper operation and maintenance of the equipment as described in Part 3 of this section.

1.07 Manufacturers Warranty

A. The pump station manufacturer shall warrant all equipment to be of quality construction, free of defects in material and workmanship. A written warranty shall include specific details described below.

1. In addition to defects in material and workmanship, fiberglass reinforced polyester station enclosures (where applicable) are warranted for sixty (60) months to be resistant to rust, corrosion, corrosive soils, effects of airborne contamination or physical failures occurring in normal service for the period of the pump station warranty.

2. All other equipment, apparatus, and parts furnished shall be warranted for sixty (60) months, excepting only those items that are normally consumed in service, such as light bulbs, oils, grease, packing, gaskets, O-rings, etc. The pump station manufacturer shall be solely responsible for warranty of the station and all components.

B. Components failing to perform as represented by the manufacturer or as proven defective in material or workmanship during the warranty period, shall be repaired, replaced, or modified by the manufacturer.

C. It is not intended that the station manufacturer assume liability for consequential damages or contingent liabilities arising from failure of any vendor supplied product or part which fails to properly operate, however caused. Consequential damages resulting from defects in design, or delays in delivery are also beyond the manufacturer's scope of liability.

D. Equipment supplied by others and incorporated into a pump station or enclosure is not covered by this limited warranty. Any warranty applicable to equipment selected or supplied by others will be limited solely to the warranty, if any, provided by the manufacturer of the equipment.

E. This limited warranty shall be valid only when installation is made and use and maintenance is performed in accordance with manufacturer recommendations. A start-up report competed by an authorized manufacturer’s representative must be received by manufacturer within thirty (30) days of the initial date the unit is placed into service. The warranty shall become effective on the date of acceptance by the purchaser or the purchaser's authorized agent, or sixty (60) days after installation, or ninety (90) days after shipment from the factory, whichever occurs first.

PART 2 - PRODUCT

A. Unitary Responsibility

B. In order to unify responsibility for proper operation of the complete pumping station, it is the intent of these Specifications that all system components be furnished by a single supplier (unitary source). The pumping station must be of standard catalog design, totally warranted by the manufacturer. Under no circumstances will a system consisting of parts compiled and assembled by a manufacturer's representative or distributor be accepted.

2.02 Manufacturer

A. The pump station system integrator must be ISO 9001 certified, with scope of registration including design control and service after sales activities.

B. The specifications and project drawings depict equipment and materials manufactured by The Gorman-Rupp Company which are deemed most suitable for the service anticipated. It is not intended, however, to eliminate other products of equal quality and performance. The contractor shall prepare his bid based on the specified equipment for purposes of determining low bid. Award of a contract shall constitute an obligation to furnish the specified equipment and materials.

C. After execution of the contract, the contractor may offer substitutions to the specified equipment for consideration. The equipment proposed for substitution must be superior in construction and performance to that specified in the contract, and the higher quality must be demonstrated by a list of current users of the proposed equipment in similar installations.

D. In event the contractor obtains engineer's approval for equipment substitution, the contractor shall, at his own expense, make all resulting changes to the enclosures, buildings, piping or electrical systems as required to accommodate the proposed equipment. Revised detail drawings illustrating the substituted equipment shall be submitted to the engineer prior to acceptance.

E. It will be assumed that if the cost to the contractor is less for the proposed substitution, then the contract price shall be reduced by an amount equal to the savings.

2.03 Unit Base

A. The unit base shall comprise a base plate, perimeter flange, and reinforcements. Base plate shall be fabricated of steel not less than 1/4" thick. Perimeter flange and reinforcements shall be designed to prevent flexing or warping under operating conditions. Base plate and/or flange shall be drilled for hardware used to secure unit base to concrete pad as shown on the contract drawings. Unit base shall contain provisions for lifting the complete pump unit during shipping and installation.

2.04 Pump Design

A. Pumps shall be horizontal, self-priming centrifugal type, designed specifically for handling raw, unscreened, domestic sanitary sewage. Pump solids handling capability and performance criteria shall be in accordance with requirements listed under PART 1 - GENERAL of this section.

B. The pump manufacturer must be ISO 9001 certified, with scope of registration including design control and service after sales activities.

C. Materials and Construction Features

1. Pump casing shall be cast iron Class 30 with integral volute scroll. Casing shall incorporate following features:

a. Mounting feet sized to prevent tipping or binding when pump is completely disassembled for maintenance.

b. Fill port coverplate, 3 1/2" diameter, shall be opened after loosening a hand nut/clamp bar assembly. In consideration for safety, hand nut threads must provide slow release of pressure, and the clamp bar shall be retained by detente lugs. A Teflon gasket shall prevent adhesion of the fill port cover to the casing.

c. Casing drain plug shall be at least 1 1/4" NPT to insure complete and rapid draining.

d. Liquid volume and recirculation port design shall be consistent with performance criteria listed under PART 1 - GENERAL of this section.

2. Coverplate assembly shall be cast iron Class 30. Design must incorporate following maintenance features:

a. A lightweight inspection coverplate, retained by acorn nuts, for access to pump interior for removal of stoppages. Designs that require removal of complete coverplate assembly for access to the impeller will not be accepted.

b. Retained by acorn nuts for complete access to pump interior. Back coverplate removal must allow service to the impeller, seal, wear plate or check valve without removing suction or discharge piping. Back coverplate shall incorporate an obstruction free flow path by combining four support posts into a two-point “webbed” plate design for increased durability, reduced clogging, and increased operational efficiency.

1) A replaceable wear plate secured to the back cover plate by studs and nuts. Wear plate shall be self-cleaning design ensuring that debris is cleared away and does not collect on the impeller vanes.

2) The nature of the conveyed medium poses significant challenges to the continuous operation of the pump. Of particular concern is the clogging of the impeller by debris in the pumped medium including but not limited to long rags, fibers, and like debris which are able to wrap around the impeller vanes, stick to the center of the vanes or hub, or lodge within the spaces between the impeller and the housing.

c. In consideration for safety, a pressure relief valve shall be supplied in the inspection coverplate. Relief valve shall open at 75-200 PSI.

d. One O-ring of Buna-N material shall seal inspection coverplate to back coverplate.

e. Two O-rings of Buna-N material shall seal back coverplate to pump casing.

f. Pusher bolt capability to assist in removal of inspection coverplate or back coverplate. Pusher bolt threaded holes shall be sized to accept same retaining capscrews as used in rotating assembly.

g. Easy-grip handle shall be mounted to face of inspection coverplate.

3. Rotating assembly, which includes impeller, shaft, mechanical shaft seal, lip seals, bearings, seal plate and bearing housing, must be removable as a single unit without disturbing the pump casing or piping. Design shall incorporate following features:

a. Seal plate and bearing housing shall be cast iron Class 30. Separate oil filled cavities, vented to atmosphere, shall be provided for shaft seal and bearings. Cavities must be cooled by the liquid pumped. Three lip seals will prevent leakage of oil.

1) The bearing cavity shall have an oil level sight gauge and fill plug check valve. The clear sight gauge shall provide easy monitoring of the bearing cavity oil level and condition of oil without removal of the fill plug check valve. The check valve shall vent the cavity but prevent introduction of moist air to the bearings.

2) The seal cavity shall have an oil level sight gauge and fill/vent plug. The clear sight gauge shall provide easy monitoring of the seal cavity oil level and condition of oil without removal of the fill/vent plug.

3) Double lip seal shall provide an atmospheric path providing positive protection of bearings, with capability for external drainage monitoring.

b. Impeller shall be ductile iron, two-vane, semi-open, non-clog, with integral pump out vanes on the back shroud. Impeller shall thread onto the pump shaft and be secured with a lockscrew and conical washer.

c. Shaft shall be AISI 4140 alloy steel unless otherwise specified by the engineer, in which case AISI 17-4 pH stainless steel shall be supplied.

d. Bearings shall be anti-friction ball type of proper size and design to withstand all radial and thrust loads expected during normal operation. Bearings shall be oil lubricated from a dedicated reservoir. Pump designs which use the same oil to lubricate the bearings and shaft seal shall not be acceptable.

e. Shaft seal shall be cartridge oil lubricated mechanical type. The stationary and rotating seal faces shall be tungsten titanium carbide alloy. Each mating surface shall be lapped to within three light bands flatness (35 millionths of an inch), as measured by an optical flat under monochromatic light. The stationary seal seat shall be double floating by virtue of a dual O-ring design; an external O-ring secures the stationary seat to the seal plate, and an internal O-ring holds the faces in alignment during periods of mechanical or hydraulic shock (loads which cause shaft deflection, vibration, and axial/radial movement). Elastomers shall be viton; cage and spring to be stainless steel. Seal shall be oil lubricated from a dedicated reservoir. The same oil shall not lubricate both shaft seal and shaft bearings. Seal shall be warranted in accordance with requirements listed under PART 1 - GENERAL of this section.

f. Pusher bolt capability to assist in removal of rotating assembly. Pusher bolt threaded holes shall be sized to accept same capscrews as used for retaining rotating assembly.

4. Adjustment of the impeller face clearance (distance between impeller and wearplate) shall be accomplished by external means.

a. Clearances shall be maintained by a four-point external shimless coverplate adjustment system, utilizing a four collar and four adjusting screw design allowing for incremental adjustment of clearances by hand as required. Each of the four points shall be lockable to prevent inadvertent clearance increases or decreases due to equipment vibration or accidental operator contact. The four point system also allows for equal clearance gaps at all points between the impeller and wear plate. Requirement of realignment of belts, couplings, etc., shall not be acceptable. Coverplate shall be capable of being removed without disturbing clearance settings. Clearance adjustment systems that utilize less than four points will not be considered.

b. There shall be provisions for additional clearance adjustment in the event that adjustment tolerances have been depleted from the coverplate side of the pump. The removal of stainless steel shims from the rotating assembly side of the pump shall allow for further adjustment as described above

c. Clearance adjustment which requires movement of the shaft only, thereby adversely affecting seal working length or impeller back clearance, shall not be acceptable.

5. Suction check valve shall be molded Neoprene with integral steel and nylon reinforcement. A blow-out center shall protect pump casing from hydraulic shock or excessive pressure. Removal or installation of the check valve must be accomplished through the coverplate opening, without disturbing the suction piping. Sole function of check valve shall be to save energy by eliminating need to reprime after each pumping cycle. Pumps requiring a suction check valve to assist reprime will not be acceptable.

6. Spool flanges shall be one-piece cast iron, class 30 fitted to suction and/or discharge ports. Each spool shall have one 1-1/4" NPT and one 1/4" NPT tapped hole with pipe plugs for mounting gauges or other equipment.

D. Serviceability
1. The pump manufacturer shall demonstrate to the engineer's satisfaction that consideration has been given to reducing maintenance costs.

2. No special tools shall be required for replacement of any components within the pump.

2.06 Drain Kit

A. Pumps to be supplied with a drain kit for ease of maintenance. The kit to contain 10' length of reinforced plastic hose with a female quick connect fitting at one end, and factory installed drain fittings in each pump. Fittings include a stainless steel pipe nipple, stainless steel bushing, stainless steel gate valve and aluminum male quick connect fitting.

2.07 Spare Parts Kit

A. The following minimum spare parts shall be furnished with the pump station:

1. One spare pump mechanical seal (complete with shaft sleeve).
2. One cover plate O-Ring.
3. One rotating assembly O-Ring.
4. One set of impeller clearance adjustment shims.

2.08 Valves & Piping

A. Each pump shall be equipped with a full flow type check valve capable of passing a 3" spherical solid. Valve shall be constructed with flanged ends and fitted with an external lever and torsional spring. Valve seat shall be constructed of stainless steel, secured to the body to ensure concentricity, sealed by an O-ring, and shall be replaceable. The valve body shall be cast iron incorporating a clean-out port large enough to allow removal and/or replacement of the valve clapper without removing valve or piping from the line. Valve clapper shall have a molded neoprene seating surface incorporating low pressure sealing rings. Valve hinge pin and internal hinge arm shall be stainless steel supported on each end in brass bushings. Shaft nut shall have double O-rings which shall be shall be easily replaceable without requiring access to interior of valve body. All internal hardware shall be stainless steel. Valve shall be rated at 175 PSI water working pressure, 350 PSI hydrostatic test pressure. Valves other than full flow type or valves mounted in such a manner that prevents the passage of a 3" spherical solid shall not be acceptable.

B. A 3-way plug valve must allow either or all pumps to be isolated from the force main. Valve shall pass 3" spherical solids. The plug valve shall be non-lubricated, tapered type. Valve body shall be semi-steel with flanged end connections drilled to 125 pound standard. The drip-tight shutoff plug shall be mounted in stainless steel bearings, and shall have a resilient facing bonded to the sealing surface.

Valve shall be operated with a single lever actuator providing lift, turn, and reseat action. The lever shall have a locking device to hold the plug in the desired position.

C. Automatic air release valves:

1. An automatic air release valve shall be furnished for each pump designed to permit the escape of air to the atmosphere during initial priming or unattended repriming cycles. Upon completion of the priming cycle or repriming cycle, the valve shall close to prevent recirculation. Valves shall provide visual indication of valve closure, and shall operate solely on discharge pressure. Valves which require connection to the suction line shall not be acceptable.

2. All valve parts exposed to sewage shall be constructed of cast iron, stainless steel, or similar corrosion resistant materials. Diaphragms, if used, shall be of fabric reinforced neoprene or similar inert material.

3. A cleanout port, three inches in diameter, shall be provided for ease of inspection, cleanout, and service.

4. Valves shall be field adjustable for varying discharge heads.

5. Connection of the air release valves to the station piping shall include stainless steel fittings.

D. Gauge Kit

1. A gauge kit shall be supplied for each pump. Suction pressure must be monitored by a glycerin-filled compound gauge, and discharge pressure by a glycerin-filled pressure gauge. Gauges to be at least 4 inches in diameter, graduated in feet water column. Rated accuracy shall be 1% of full scale reading. Compound gauge shall be graduated -34 to +34 feet water column minimum. Pressure gauge to be graduated 0 to 140 feet water column minimum.

2. Gauges to be factory mounted on a resilient panel with frame assembly secured to pumps or piping. Gauge installations shall be complete with all hoses and stainless steel fittings, including a shutoff valve for each gauge line at the point of connection to suction and discharge pipes.

E. Station Enclosure Low Temperature Alarm

1. Pump station shall be supplied with a thermostat which shall monitor interior station temperature. The control shall incorporate an unpowered dry contact wired to terminal blocks for field connection to a remote alarm device. The contact will close in the event that the temperature within the enclosure falls below approximately 35 degrees F.

F. Piping

1. Flanged header pipe shall be centrifugally cast, ductile iron, complying with ANSI/AWWA A21.51/C115 and class 53 thickness.

2. Flanges shall be cast iron class 125 and Comply with ANSI B16.1.

3. Pipe and flanges shall be threaded and suitable thread sealant applied before assembling flange to pipe.

4. Bolt holes shall be in angular alignment within 1/2 degrees between flanges. Flanges shall be faced with a gasket finish having concentric grooves a minimum of 0.01 inch deep by approximately 0.03 inch wide, with a minimum of three grooves on any given surface spaced a maximum of 1/4 inch apart.

G. Supports and Thrust Blocks

1. Contractor must insure all pipes connected to the pump station are supported to prevent piping loads from being transmitted to pumps or station piping. Pump station discharge force main piping shall be anchored with thrust blocks where shown on the contract drawings.

2.09 FINISH

A. Pumps, piping, and exposed steel framework shall be cleaned prior to coating using an approved solvent wipe or phosphatizing cleaner. The part must thoroughly dry before paint application. Open joints shall be caulked with an approved polyurethane sealant. Exposed surfaces shall be applied with one coat of Tnemec Series 69 Polymide Epoxy Primer and one finish coat of Series 73 Aliphatic Acrylic Polyurethane for a total dry film thickness of 4-6 mils. Finish coat shall be semi-gloss white for optimum illumination and enhancement. The coating shall be corrosion, moisture, oil, and solvent resistant when completely dry. The factory finish shall allow for over-coating and touch-up for 6 months after coating. Thereafter, it will generally require sanding to accept a topcoat or touch-up coating. See Product Data Sheet for additional information.

2.10 Electrical Components

A. The pump station control panel will be tested as an integral unit by the pump station manufacturer. The control panel shall also be tested with the pump station as a complete working system at the pump station manufacturer's facility.

2.11 Panel Enclosure

A. Electrical control equipment shall be mounted within a NEMA 1 steel, dead front type, control enclosure. Door shall be hinged and sealed with a neoprene gasket and equipped with captive closing hardware. Control components shall be mounted on a removable steel back panel secured to enclosure with collar studs.

B. All control devices and instruments shall be secured to the sub-plate with machine screws and lockwashers. Mounting holes shall be drilled and tapped; self-tapping screws shall not be used to mount and component. All control devices shall be clearly labeled to indicate function.

2.12 UL Label Requirement

A. Pump station controls shall conform to third party safety certification. The panel shall bear a serialized UL label listed for "Enclosed Industrial Control Panels". The enclosure, and all components mounted on the sub-panel or control cover shall conform to UL descriptions and procedures.

2.13 Branch Components

A. All motor branch and power circuit components shall be of highest industrial quality. The short circuit current rating of all power circuit devices shall be a tested combination or evaluated per the National Electrical Code Article 409. the lowest rated power circuit component shall be the overall control panel short circuit rating and shall not be less than the fault current available. The minimum control panel rating shall not be less than 10 kA, rms symmetrical. Control assemblies operating at 120 volts nominal or less may be provided with transformers which limit the fault current and may be rated less than the minimum required short circuit rating.

B. Circuit Breakers and Operating Mechanisms

1. A properly sized heavy duty circuit breaker shall be furnished for each pump motor. The circuit breakers must be sealed by the manufacturer after calibration to prevent tampering.

2. An operating mechanism installed on each motor circuit breaker shall penetrate the control panel door. A padlockable operator handle shall be secured on the exterior surface. Interlocks must prevent opening the door until circuit breakers are in "OFF" position. An additional mechanism(s) shall be provided on the circuit breaker permitting the breaker to be operated and/or locked with the control panel door in the open position.

C. Motor Starter

1. An open frame, across-the-line, NEMA rated magnetic starter with under-voltage release, and overload protection on all three phases, shall be furnished for each pump motor. Starters of NEMA size 1 and above shall allow addition of at least two auxiliary contacts. Starters rated "0", "00", or fractional size are not acceptable. Power contacts to be double-break type made of cadmium oxide silver. Coils to be epoxy molded for protection from moisture and corrosive atmospheres. Contacts and coils shall be easily replaceable without removing the starter from its mounted position. Each starter shall have a metal mounting plate for durability.

2. Overload relays shall be solid-state block type, having visual trip indication with trip-free operation. Electrically resetting the overload will cause one (1) normally open and one (1) normally closed isolated alarm/control contact to reset, thus re-establishing a control circuit. Trip setting shall be governed by solid-state circuitry and adjustable current setting. Trip classes shall be 10, 15 and 20. Additional features to include phase loss protection, selectable jam/stall protection and selectable ground fault protection.

3. An overload reset pushbutton, mounted through the control panel door, shall permit resetting the overload relays without opening the control panel door.

D. Starter: A reduced voltage, solid state motor starter shall be furnished for each pump motor. The starter construction shall be modular with separately replaceable power and control sections. The power section shall consist of six back-to-back SCR's rated 208 to 480 volts, 50/60 hertz. The SCR's shall have a minimum repetitive peak inverse voltage rating of 1400 volts at 480 volts. The enclosed operating temperature range shall be 0 to 40 degrees C at altitudes up to 2000 meters without derating.

1. Starting Modes: Starting modes shall be selectable soft start, current limit, or full voltage. Soft starting the pump shall include an adjustable initial torque value of 0 to 90 %. The acceleration ramp shall be adjustable from 0 to 30 seconds. The starter shall include a selectable kick start providing a current pulse at start. Kick start level shall be adjustable from 0 to 90% of locked rotor torque. Kick start time shall be adjustable from 0 to 2 seconds. Current limit mode shall provide means for limiting the starting current to a programmable value between 50 and 600% of full load current. Full voltage start shall provide across the line starting with a ramp time of less than 0.25 seconds.

2. Pump Control Mode: Ramp time will be dependent on pump torque requirements. The starter shall provide smooth acceleration and deceleration, which approximates the flow rate of a centrifugal pump. The starter's microcomputer shall analyze motor variables and generate control commands, which will minimize surges in the system. Pump stop time shall be adjustable from 0 to 120 seconds. Pump control provides reduced hydraulic shock.

3. Bypass: When the start ramp time is complete, the starter shall energize an integral bypass contactor. When in the bypass mode, the bypass contactor shall carry the motor load to minimize internal heating in the electrical enclosure.

4. Protection: The starter shall include protective features: Communication fault, control temperature, excess starts/hour, stall, jam, line fault, open gate, overload, overvoltage, phase reversal, power loss, underload, undervoltage, shorted SCR, open bypass and voltage unbalance.

    a) An integral electronic overload relay equipped with thermal memory shall be included and shall utilize three phase current sensing. Adjustments shall include trip current, service factor and 10, 15, 20 or 30 trip class.

    b) Jam trip shall be adjustable 0-1,000% of the nominal motor current with a delay time adjustment of 0-99 seconds.

    c) Stall protection senses that the motor is not up-to-speed at end of ramp and will shut down after a user-selected delay time has elapsed. Stall delay shall be adjustable from 0-10 seconds.

    d) Fault diagnostics shall be displayed on the starter and shall include temperature fault, line fault, open gate and power loss.

5. Display: The starter shall include a keypad and display on the front of the control module. The display is equipped with a built-in four line, 16 character backlit LCD. The LCD displays metering, faults and parameter settings in English. Faults will display in English and fault code. A fault buffer will store the last five faults. Metering capabilities shall include: Three phase current, three phase voltage, power factor, motor thermal usage, wattmeter, kilowatt hours, and elapsed time meter. Digital parameter adjustments shall be made using the keypad.

6. Door Mounted Display: Each starter shall be furnished with a display and keypad mounted to the door of the control panel. The door mounted display will duplicate the functions of the starter display and allow the operator to monitor or change parameters without opening the control panel door.

2.14 Phase Monitor

A. The control panel shall be equipped to monitor the incoming power and shut down the pump motors when required to protect the motor(s) from damage caused by phase reversal, phase loss, low voltage, and voltage unbalance. An integral time delay shall be provided to minimize nuisance trips. The motor(s) shall automatically restart when power conditions return to normal.

2.15 Surge Protective Device

A. All Control Panels shall have Surge Protective Devices installed immediately after the main overcurrent device or immediately after the supply conductors to the panel have been terminated. The Surge Protective Device(s) shall follow IEEE C62.41 recommendation for cascading to protect all voltage levels to and including 24 volts AC/DC and shall be as follows:
B. Be UL 1449 3rd Edition Recognized for UL Type 2 applications except at 48 volts AC/DC and below may be UL 1449 3rd Edition for Type 3 applications.
C. Provide suppression for both normal mode (L-N [Wye]) and common mode (L+N-G [Wye] or L-G [Delta]).
D. Have a Surge Current Capacity (Imax) of at least 40kA.
E. Have a Nominal Surge Current Rating (In) of 20kA.
F. Have SCCRs of 200kA, except that 347Y/600V, 240/480V High leg Delta and 347V single-phase SPDs shall have a minimum SCCR of 125kA.
G. Use MOV technology with thermal disconnect.
H. Be RoHS compliant.
I. SPD status monitoring shall be provided by local visual indication and, if needed, by remote contact signaling using an optional Form C contact relay.

J. Hardwired Listed Type 1 or Type 2 Surge Protective Devices Shall:

1. All Type 1 or Type 2 surge protective devices shall be manufactured by a single ISO-9001 registered company normally engaged in the design, development and manufacture of such devices for electrical distribution system/ equipment protection. Surge protective devices shall be UL Listed with a Short-Circuit Current Rating of 200kA, Nominal Discharge Current (In) of 20kA, and Surge Current Capacity (Imax) of120kA, 200kA, 300kA or 400kA. These SPDs shall be installed in accordance with the NEC® and/or local code requirements. The said manufacturer shall offer a minimum five (5) year warranty for its Type 1 and Type 2 surge protective devices.
2. The hardwired surge protective device shall have specifications as shown below:

   a) The Maximum Continuous Operating Voltage (MCOV) shall not exceed 25% on Wye and 40% on Delta systems of the nominal voltage (system voltage) in the configuration being used
   b) Prewired NEMA 1 or NEMA 4X factory sealed enclosure suitable for the intended installation location
   c) Shall have a two color LED status indicator per phase
   d) Have an operating temperature range of at least -40˚C to +50˚C
   e) Only use thermally protected MOV technology, such as Bussmann SurgePOD™.

3. Surge Protective Device Agency Information: SPDs shall be "Listed" by Underwriters Laboratories, Inc. to UL 1449 3rd Edition as a Type 1 or Type 2 device and shall exhibit the UL Listing mark for the UL category VZCA for USA and/or VZCA2 for Canada; and must have CSA certification.
4. Manufacturers must provide verification of performance data for UL and CSA standards.
5. All SPDs must be RoHS compliant.
6. Surge protective devices shall be installed and located in accordance with the all applicable gency, NEC® and local code requirements. The SPDs must be suitable for the particular installation, be it on the upstream side (Type 1) or downstream side (Type 1 or Type 2) of service entrance Overcurrent Protective Device (OCPD).
7. All SPDs shall match voltage and system specific requirements as provided by the manufacturer.
8. All SPDs shall provide surge protection for both normal mode (L-N [Wye], L-L [Delta]) and common mode (L+N-G [Wye] or L-G [Delta]).
9. Surge protective device shall be clearly marked with specifications as required by UL 1449 3rd Edition along with UL holographic label on the SPD.
10. Each surge protective device should be serial numbered along with barcode for easy identification and traceability.

2.16 Pump Start Delay

A. The control circuit for pump #2 shall be equipped with a time delay to prevent simultaneous motor starts.

2.17 Control Circuit

A. A normal duty thermal-magnetic circuit breaker shall protect all control circuits by interrupting control power.

B. Pump mode selector switches shall permit manual start or stop of each pump individually, or permit automatic operation under control of the liquid level control system. Manual operation shall override all shutdown systems, except the motor overload relays. Selector switches to be oil-tight design with contacts rated NEMA A300 minimum.

C. Control logic shall be accomplished using a programmable controller.

D. Electromechanical relays and timers shall be equipped with 120VAC coils and contacts rated Nema A-300 minimum. Timers shall be pneumatic or synchronous motor driven.

E. Programmable controls shall operate on 120VAC power and be equipped with 120VAC inputs and hard contact outputs. Outputs shall have an inductive load rating equivalent to a size 4 contactor. Inputs shall incorporate a filter time delay and the overall controller noise immunity shall meet Nema standard ICS 2-230. The power supply to the programmable control shall include an active tracking filter protection system to minimize the effects of electrical noise.

F. Operator interface equipment shall be provided to permit field adjustment of the programmable control timers and counters and shall be mounted on the control panel with other operator controls and displays.

G. The program logic shall be stored in battery backed random access memory, as well as on a programmable, read only memory module. The memory module shall be included to facilitate field repair or replacement of the programmable control hardware.

H. The O&M manual shall be provided with complete ladder logic program documentation including English names, rung comments, and coil/contact cross-references.

I. The control shall be pre-programmed or wired to provide the following routines:

1. Pump alternation at lead stop
2. Excessive pump run time alternation (1-9999 minutes)
3. Jump to idle pump/drive on lead failure
4. Pump start delays after power restoration
5. Flashing alarm/steady acknowledge on all alarm pilot lights
6. Station trouble alarm (115vac and normally open dry contact)
7. High and low level alarms
8. Pump high temperature shutdown
9. Motor high tempeature

J. The control system shall be equipped with the following dry contacts wired to the terminal blocks at minimum:

1. Pump run - (1) N.O. each pump
2. Drive fault - (1) N.O. each pump
3. High pump temperature shutdown - (1) N.O. each pump
4. High motor temperature - (1) N.O. each pump
5. Three phase voltage monitor - (1) N.C.
6. High water alarm - (1) N.O.
7. Low water alarm *(optional)*- (1) N.O.

K. Six digit elapsed time meter shall be shall be displayed on the Integrinex™ Standard operator interface to indicate total running time of each pump in "hours" and "tenths of hours". Pump runtime shall be adjustable and password protected.

L. A high pump temperature protection circuit shall override the level control and shut down the pump motor(s) when required to protect the pump from excessive temperature. A thermostat shall be mounted on each pump casing and connected to the Integrinex™ Standard. If casing temperature rises to a level sufficient to cause damage, the thermostat causes the Integrinex™ Standard to interrupt power to the motor. The Integrinex™ Standard will display an alarm banner indicating the motor stopped due to high pump temperature. The motor shall remain locked out until the pump has cooled and circuit has been manually reset. Automatic reset of this circuit is not acceptable.

M. A duplex ground fault receptacle providing 115 VAC, 60 Hz, single phase current, will be mounted on the side of the control enclosure. Receptacle circuit shall be protected by a 15 ampere thermal-magnetic circuit breaker.

N. Auxiliary Power Transformer

1. The lift station shall be equipped with a 5 KVA step-down transformer to supply 115 volt, AC, single phase for the control and auxiliary equipment. The primary and secondary side of the transformer to be protected by a thermal magnetic circuit breaker, sized to meet the power requirements of the transformer. An operating mechanism shall penetrate the control panel door. and a padlockable operator handle shall be secured on the exterior surface. Interlocks must prevent opening the door until circuit breakers are in "OFF" position. An additional mechanism(s) shall be provided on the circuit breaker permitting the breaker to be operated and/or locked with the control panel door in the open position.

O. Wiring

1. The pump station, as furnished by the manufacturer, shall be completely wired, except for power feed lines to the branch circuit breakers and final connections to remote alarm devices.

2. All wiring, workmanship, and schematic wiring diagrams shall comply with applicable standards and specifications of the National Electric Code (NEC).\

3. All user serviceable wiring shall be type MTW or THW, 600 volts, color coded as follows:

a) Line and Load Circuits, AC or DC power ..... Black
b) AC Control Circuit Less Than Line Voltage ..... Red
c) DC Control Circuit ..... Blue
d) Interlock Control Circuit from external source ..... Yellow
e) Equipment Grounding Conductor..... Green
f) Current CarryingGround..... White
g) Hot with circuit breaker open..... Orange

4. Control circuit wiring inside the panel, with exception of internal wiring of individual components, shall be 16 gauge minimum, type MTW or THW, 600 volts. Power wiring to be 14 gauge minimum. Motor branch wiring shall be 10 gauge minimum.\

5. Motor branch and other power conductors shall not be loaded above the temperature rating of the connected termination. Wires must be clearly numbered at each end in conformance with applicable standards. All wire connectors in the control panel shall be ring tongue type with nylon insulated shanks. All wires on the sub-plate shall be bundled and tied. All wires extending from components mounted on door shall terminate at a terminal block mounted on the back panel. All wiring outside the panel shall be routed through conduit.

6. Control wires connected to door mounted components must be tied and bundled in accordance with good commercial practice. Bundles shall be made flexible at the hinged side of the enclosure. Adequate length and flex shall allow the door to swing full open without undue stress or abrasion. Bundles shall be held on each side of hinge by mechanical fastening devices.

P. Conduit

1. Factory installed conduit shall conform to following requirements:

a) All conduit and fittings to be UL listed.

b) Liquid tight flexible metal conduit to be constructed of smooth, flexible galvanized steel core with smooth abrasion resistant, liquid tight polyvinyl chloride cover.

c) Conduit to be supported in accordance with articles 346, 347, and 350 of the National Electric Code.

d) Conduit shall be sized according to the National electric Code.

Q. Grounding

1. Station manufacturer shall ground all electrical equipment inside the pump station to the control panel back plate. All paint must be removed from the grounding mounting surface before making final connection.

2. The contractor shall provide an earth driven ground connection to the pump station at the main grounding lug in accordance with the National Electric Code (NEC).

R. Equipment Marking

1. Permanent corrosion resistant name plate(s) shall be attached to the control and include following information:

a) Equipment serial number
b) Control panel short circuit rating
c) Supply voltage, phase and frequency
d) Current rating of the minimum main conductor
e) Electrical wiring diagram number
f) Motor horsepower and full load current
g) Motor overload heater element
h) Motor circuit breaker trip current rating
i) Name and location of equipment manufacturer

2. Control components shall be permanently marked using the same identification keys shown on the electrical diagram. Labels shall be mounted adjacent to device being identified.

3. Switches, indicators, and instruments mounted through the control panel door shall be labeled to indicate function, position, etc. Labels shall be mounted adjacent to, or above the device.

2.18 Primary Liquid Level Control System

A. The manufacturer of the liquid level control system must be ISO 9001 certified, with scope of registration including design control and service after sales activities.

B. The level control system shall start and stop the pump motors in response to changes in wet well level, as set forth herein.

C. The level control system shall be capable of operating as either an air bubbler type level control system, submersible transducer type system, or ultrasonic transmitter type system.

D. The level control system shall utilize alternation to select first one pump, then the second pump, then the third pump (if required), to run as lead pump for a pumping cycle. Alternation shall occur at the end of a pumping cycle, or in the event of excessive run time.

E. The level control system shall utilize an electronic pressure switch which shall continuously monitor the wet well level, permitting the operator to read wet well level at any time. Upon operator selection of automatic operation, the electronic pressure switch shall start the motor for one pump when the liquid level in the wet well rises to the "lead pump start level". When the liquid is lowered to the "lead

pump stop level", the electronic pressure switch shall stop this pump. These actions shall constitute one pumping cycle. Should the wet well level continue to rise, the electronic pressure switch shall start the second and/or third pump (if required) when the liquid reaches the "lag pump start level", or “standby pump start level” so that all pumps are operating. These levels shall be adjustable as described below.

1. The electronic pressure switch shall include integral components to perform all pressure sensing, signal conditioning, EMI and RFI suppression, DC power supply and 120 volt outputs. Comparators shall be solid state, and shall be integrated with other components to perform as described below.

2. The electronic pressure switch shall be capable of operating on a supply voltage of 12-24Vdc in an ambient temperature range of -10 degrees C (14 degrees F) through 55 degrees C (131 degrees F). Ingress Protection of IP56 for indoor use with closed cell neoprene blend gasket material. Evaluated by Underwriters Laboratories for Pollution Degree 2 device for U.L. and cU.L. Control range shall be 0 to 33.3 feet of water with an overall repeat accuracy of (plus/minus) 0.1 feet of water. Memory shall be non-volatile. A Battery backed real time clock shall be standard.

3. Eleven optically isolated, user defined digital inputs for pump and alarm status. Rated at 10mA at 24Vdc. Eight digital output relays (mechanical contacts), configurable for pump start/stop or alarms. Three relays rated at 12 Amp @ 28Vdc and 120Vac, five relays rated at 3 Amp @ 30Vdc and 120Vac. The electronic pressure switch shall consist of the following integral components: pressure sensor, display, electronic comparators, digital inputs and digital output relays.

    a. The internal pressure sensor shall be a strain gauge transducer and shall receive an input pressure from the air bubbler system. The transducer shall convert the input to a proportional electrical signal for distribution to the display and electronic comparators. The transducer output shall be filtered to prevent control response to level pulsations or surges. The transducer range shall be 0-14.5 PSI, temperature compensated from -40 degrees C (-40 degrees F) through 85 degrees C (185 degrees F), with a repeat accuracy of (plus/minus) 2.5% full scale about a fixed temperature. Transducer overpressure rating shall be 3 times full scale.

    b. The electronic pressure switch shall incorporate a digital back lighted LCD panel display which, upon operator selection, shall indicate liquid level in the wet well, and pump status indication for up to 3 pumps. The display shall include a 128 x 64 bit resolution LCD to read out directly in feet of water, accurate to within one-tenth foot (0.1 foot), with a full scale indication of not less than 12 feet. The display shall be easily convertible to indicate English or metric units.

    c. Level adjustments shall be electronic comparator set-points to control the levels at which the lead, lag and standby pumps start and stop. Each of the level settings shall be easily adjustable with the use of membrane type switches, and accessible to the operator without opening any cover panel on the electronic pressure switch. Controls shall be provided to permit the operator to read the selected levels on the display. Such adjustments shall not require hard wiring, the use of electronic test equipment, artificial level simulation or introduction of pressure to the electronic pressure switch.

    d. Each digital input can be programmed as pump run, pump HOA, pump high temp, pump moisture/thermal, starter failure (FVNR, RVSS, VFD), and phase failure. Inputs are used for status and alarm indication.

    e. Each output relay in the electronic pressure switch shall be hard contact mechanical style. Each relay input shall be optically isolated from its output and shall incorporate zero crossover switching to provide high immunity to electrical noise. Each output relay shall have an inductive load rating equivalent to one NEMA size 3 contactor. A pilot relay shall be incorporated for loads greater than a size 3 contactor.

4. The electronic pressure switch shall be equipped with alarm banners with time and date history for displaying alarm input notification. Alarm history will retain a 16 of the most recent alarm events.

5. The electronic pressure switch shall be equipped with pump start/stop and alarm input delay(s) that have an adjustable delay set points.

6. An Antiseptic function with a built in timer shall be incorporated in the electronic pressure switch to prevent the well from becoming septic.

7. The electronic pressure switch shall be capable of jumping to next available pump if current pump is out of service due to pump failure or manual selection. Circuit design in which application of power to the lag pump motor starter is contingent upon completion of the lead pump circuit shall not be acceptable.

8. The electronic pressure switch shall be equipped with a simulator system capable of performing system cycle testing functions.

9. The electronic pressure switch shall be capable of calculating and displaying pump elapse run time. The elapse run time is resettable and adjustable.

10. The electronic pressure switch shall have internal capability of providing automatic simplex, duplex, and triplex alternation, manual selection of pump sequence operation, and alternation in the event of 1-24 hours of excessive run time.

11. The electronic pressure switch shall be equipped with a security access code to prevent accidental set-up changes and provide liquid level set-point lock-out. The supervisor access code is adjustable.

12. The electronic pressure switch shall be equipped with one (1) 0-33 ft. W.C. input, one (1) scalable analog input of either 0-5Vdc, or 4-20mA, and one (1) scalable analog output of either 0-5Vdc, 0-10Vdc or 4-20mA. Output is powered by 10-24Vdc supply. Load resistance for 4-20mA output shall be 100-1000 ohms.

13. The electronic pressure switch shall include a DC power supply to convert 120Vac control power to 12 or 24Vdc power. The power supply shall be 500 mA (6W) minimum and be UL listed Class II power limited power supply.

14. The electronic pressure switch shall be equipped with an electronic comparator and mechanical output relay to alert maintenance personnel to a high liquid level in the wet well. An alarm banner, visible on the front of the controller, shall indicate that a high wet well level exists. The alarm signal shall be maintained until the wet well level has been lowered and the circuit has been manually reset. High water alarm shall be furnished with a dry contact wired to terminal blocks.

15. The electronic pressure switch shall be equipped with an electronic comparator and mechanical output relay to alert maintenance personnel to a low liquid level in the wet well. An alarm banner, visible on the front of the controller, shall indicate that a low wet well level exists. The alarm signal shall be maintained until the cause for the low wet well level has been corrected and the circuit has been manually reset. A low liquid level condition shall disable all pump motors. When the wet well rises above the low level point, all pump motors shall be automatically enabled. Low water alarm shall be furnished with a dry contact wired to terminal blocks.

16. Integrinex Standard Analog Output circuit will be furnished with surge protection to protect related equipment from induced voltage spike from lighting.

F. An alarm silence pushbutton and relay shall be provided to permit maintenance personnel to de-energize the audible alarm device while corrective actions are under way. After silencing the alarm

device, manual reset of the alarm condition shall clear the alarm silence relay automatically. The pushbutton shall be a membrane style button integral to the Integrinex Standard level controller.

G. Submersible Transducer Level Sensor

1. The level control system shall utilize a submersible transducer. It shall be a strain gauge transducer with a pressure sensor housed in a 316 SST or Titanium case designed to extend into the wet well. The pressure transducer shall provide a proportional signal for distribution to the display and electronic comparators of the electronic pressure switch, and remainder of the level control system. Sensor range shall be 0-12 ft. W.C. minimum with an over-pressure rating 3 times full scale. The transducer shall have output capability of 0-5Vdc or 4-20mA. The transducer's polyurethane jacketed shielded cable shall be of suitable length for proper installation into the wet well without splicing.

2. An intrinsically safe repeater shall be supplied in the control enclosure. Repeater must be recognized and listed as intrinsically safe by a nationally recognized testing laboratory. Station manufacturer shall make all connections from repeater to feeder lines and motor controls. Installing contractor shall make connections from repeater to transducer.

3. Submersible transducer will be furnished with surge protection to protect related equipment from an induced voltage spike from lighting.

2.17 Alarm Light (External)

1. Station manufacturer will supply one 115 volt AC alarm light fixture with vapor-tight red globe, guard, conduit box, and mounting base. The design must prevent rain water from collecting in the gasketed area of the fixture, between the base and globe. The alarm light will be shipped loose for installation by the contractor.

2.18 Alarm Horn (External)

1. Station manufacturer will supply one 115 volt AC weatherproof alarm horn with projector, conduit box, and mounting base. The design must prevent rain water from collecting in any part of the horn. The alarm horn will be shipped loose for installation by the contractor

PART 3 - EXECUTION

3.01 EXAMINATION

A. Contractor shall off-load equipment at installation site using equipment of sufficient size and design to prevent injury or damage. Station manufacturer shall provide written instruction for proper handling. Immediately after off-loading, contractor shall inspect complete pump station and appurtenances for shipping damage or missing parts. Any damage or discrepancy shall be noted in written claim with shipper prior to accepting delivery. Validate all station serial numbers and parts lists with shipping documentation. Notify the manufacturer’s representative of any unacceptable conditions noted with shipper.

3.02 INSTALLATION

A. Install, level, align, and lubricate pump station as indicated on project drawings. Installation must be in accordance with written instructions supplied by the manufacturer at time of delivery.

B. Suction pipe connections are vacuum tight. Fasteners at all pipe connections must be tight. Install pipe with supports and thrust blocks to prevent strain and vibration on pump station piping. Install and secure all service lines (level control, air release valve or pump drain lines) as required in wet well.

C. Check motor and control data plates for compatibility to site voltage. Install and test the station ground prior to connecting line voltage to station control panel.

D. Prior to applying electrical power to any motors or control equipment, check all wiring for tight connection. Verify that protective devices (fuses and circuit breakers) conform to project design documents. Manually operate circuit breakers and switches to ensure operation without binding. Open all circuit breakers and disconnects before connecting utility power. Verify line voltage, phase sequence and ground before actual start-up.

3.03 FIELD QUALITY CONTROL

A. Operational Test
   1. Prior to acceptance by owner, an operational test of all pumps, drives, and control systems shall be conducted to determine if the installed equipment meets the purpose and intent of the specifications. Tests shall demonstrate that all equipment is electrically, mechanically, structurally, and otherwise acceptable; it is safe and in optimum working condition; and conforms to the specified operating characteristics.

   2. After construction debris and foreign material has been removed form the wet well, contractor shall supply clear water volume adequate to operate station through several pumping cycles. Observe and record operation of pumps, suction and discharge gage readings, ampere draw, pump controls, and liquid level controls. Check calibration of all instrumentation equipment, test manual control devices, and automatic control systems. Be alert to any undue noise, vibration or other operational problems.

B. Manufacturer's Start-up Services

   1. Co-ordinate station start-up with manufacturer's technical representative. The representative or factory service technician will inspect the completed installation. He will calibrate and adjust instrumentation, correct or supervise correction of defects or malfunctions, and instruct operating personnel in proper operation and maintenance procedures.

3.04 CLEANING

A. Prior to acceptance, inspect interior and exterior of pump station for dirt, splashed material or damaged paint. Clean or repair accordingly. Remove from the job site all tools, surplus materials, scrap and debris.

3.05 PROTECTION

A. The pump station should be placed into service immediately. If operation is delayed, drain water from pumps and piping. Open motor circuit breakers and protect station controls and interior equipment from cold and moisture.

END OF SECTION

SECTION 46 21 00

SCREENING EQUIPMENT

PART 1 GENERAL

1.1 WORK INCLUDED

This section covers the work necessary to furnish and install a complete factory built package grit removal system, all necessary tank, equipment and appurtenances for the skid mounted equipment, including screen, bar screen bypass, inlet channel, vortex grit chamber, paddle apparatus, drive, fluidizer vanes, grit well cover plate, flow control baffles, grit pump, grit concentrator, grit classifier, and controls.

Equipment within this section shall be entirely skid mounted on one unit and be supplied by one manufacturer. Control panel shall be shipped lose and skid shall be prewired to NEMA 7 junction box.

1.2 RELATED SECTIONS

A. Section 09 90 00 – Painting and Coating.

B. Division 33 - Utilities.

C. Section 40 05 09 – Hydraulic Gates

D. Division 26, Electrical, unless specified in this Section.

1.3 REFERENCES

A. Reference Standards: Comply as a minimum with applicable provisions and recommendations of the following:

1. NEC, National Electric Code.
2. NEMA, Standards of National Electrical Manufacturers Association.
3. IEEE, Institute of Electrical and Electronic Engineers.
4. AFBMA, Anti-Friction Bearing Manufacturers Association.
5. ANSI, American National Standards Institute.
6. SSPC, Steel Structures Painting Council.
7. ASTM, American Society for Testing and Materials.

1.4 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 01 33 00.

B. Submit a list of not less than five (5) installations where equipment of the type and approximate size specified herein has been in successful operation for at least two (2) years.

C. Two (2) grit removal efficiency tests shall be provided from an installations where similar equipment by the Manufacturer is currently in similar service. Each grit removal efficiency test shall meet the removal efficiency in 2.3C.

D. Submit locations of the nearest permanent service headquarters.

E. Submit descriptive literature, including a cross-sectional view of each chamber, which

indicates materials of construction, weights, principal dimensions and other important details.

F. Submit operation and maintenance data under provisions of Section 01 33 00.

G. Record Drawings: Submit record drawing under provisions of Section 01 33 00.

1.5 QUALITY ASSURANCE

A. All materials used shall be new, of high grade and of properties best suited to the Work required.

B. Manufacturer's Qualifications:

1. Grit chamber equipment provided under this Section shall submit a list of not less than five (5) installations where equipment of the same removal efficiencies as specified herein has been in successful operation for at least five (5) years.

2. Two (2) grit removal efficiency tests shall be provided from an installations where similar equipment by the Manufacturer is currently in similar service. Each grit removal efficiency test shall meet the removal efficiency in 2.3.C. A Manufacturer that does not have test data that is acceptable to the Engineer shall not be considered as an approved equal.

C. Coordination Responsibility:

1. In order to insure equipment compatibility one (1) manufacturer shall be responsible for providing all screening and grit removal equipment, including pump, classifier and controls.

2. Contractor shall retain overall responsibility for equipment coordination, installation, testing and operation.

1.6 DELIVERY, STORAGE AND HANDLING

A. Store all equipment off the ground in enclosed shelter.

1.7 GUARANTEE

A. Provide guarantee under provisions of Section _____.

B. Manufacturer shall furnish to the owner a written warranty against workmanship and material for 1 year under normal use and service. Warranty shall be in printed form and previously published as the manufacturers' Standard Warranty for similar units.

PART 2 PRODUCTS

2.1 GENERAL

A. Furnish and install the skid mounted grit removal equipment and appurtenances in accordance with these specifications and as shown on the Drawings. The unit shall be complete with the following equipment: Influent trough with slide gate, manual bypass bar screen, grit chamber, grit handling system with grit pump, grit fluidizer, valves and piping, grit conveyor with grit concentrator, two access platforms with ladders and handrails, and a control system with all auxiliary equipment, mounted on an epoxy coated steel skid, as specified herein and shown on the drawings.

B. The individual components of the complete grit removal system shall be as specified herein. The equipment manufacturer shall coordinate their sizing, placement and interconnection on the common base, so that the system operates smoothly as a single unit. A single control panel with relay controller shall operate the complete grit removal system. Disposal hoppers shall be provided by the Contractor.

C. The skid mounted system shall have an 18" flanged inlet connection and an 18" flanged outlet. Access ladders and walkways with handrails shall be provided as required for operation and maintenance access. Moving parts shall have appropriate safety guards as necessary.

2.2 MANUFACTURER

A. Smith & Loveless, Inc.

2.3 OPERATIONAL CHARACTERISTICS

A. Design each grit chamber for following hydraulic conditions.

1. Minimum Flow: 0.25
2. Maximum Flow While Maintaining Below Removal Efficiency: 2.5 MGD
3. Maximum Hydraulic Flow: 2.5 MGD

B. Construct suitable for extremely humid installation, and splash resistant.

C. Grit removal from screened raw wastewater.

Grit Size	% Removed (by Weight)
Down to 140-mesh particle size	95

D. All channels, chambers, and wettable equipment shall be 304SS.

E. Wearing parts readily accessible for inspection, repairs, and replacement.

F. Replacement parts easily duplicated and attainable.

G. No moving parts subject to wear or stoppage below water surface.

H. No bends or elbows on underwater or inaccessible grit piping.

I. Provide drives, lubrication, and support equipment bearings accessible from operating floor level.

J. No loss of grit removal efficiency for flows with inlet velocity less than 3.5 ft/s.

K. Provide inlet ramp to enhance coanda effect and direct grit downward to separation chamber.

L. Grit removal system to fit in grit tank shown on Drawings.
   1. Inlet and outlet to be separated by flow control baffle and chamber travel path to be 360°.
   2. Storage hopper to have 60° sloped bottom with a maximum diameter of 3'-0" and a minimum depth of 5'-6".

M. To maximize grit removal efficiency, the grit chamber hydraulics shall incorporate a toroidal flow path enhanced by a slow vortex. Grit chambers incorporating the gravity principle will not be acceptable due to the turbulence in the flow, which prevents gravity settling from being effective and due to the extra area needed for settling fine grit. Aerated grit chambers, including those incorporating conventional settling criteria, are also specifically unacceptable.

2.3 SCREENING EQUIPMENT

A. An automatic Spiral Fine Screen shall be mounted into the inlet trough as shown on the drawings.

B. The Spiral Fine Screen shall be capable of passing a peak flow rate of 2.5 MGD

C. The lower (submerged) portion of the screen unit shall have a U-shaped stainless steel perforated basket with 6 mm openings.

D. A shaftless screw auger, with no intermediate or underwater bearings, shall carry the collected solids off the screen and into the enclosed transport auger for gravity and compression dewatering.

E. The spiral fine screen shall be self-cleaning by means of renewable brushes bolted to the shaftless screw. The shaftless screw shall operate at no higher speed than 9 rpm, to minimize wear and insure long life.

F. The transport auger section shall be fully enclosed and have a tapered transition inlet at the bottom and a flanged discharge at the top.

G. The discharge chute shall allow screenings to be discharged into a screenings dumpster provided by others

H. The screw incline shall be 35 degrees.

I. A transport tube shall be included to allow for the movement of the captured screenings from the screen basket. This tube shall also allow for the screenings to be raised to a sufficient height for discharge up and out of the channel for discharge. Anti-wear bars will also be included and be of the bolted, sliding bar style.

J. DRIVE
   K. The shaftless screw and transport auger shall be driven by a 1.0 hp gear motor located at the discharge end of the unit. The drive shall be a parallel shaft, helical gear reducer.
   L. The motor shall be Explosion Proof 3-phase, 60-Hertz, 230/460-volt with a 1.15 Service Factor, NEMA Design B with class F insulation.

M. The screw speed shall be 9 RPM or less.
N. The drive shall be mounted on a plate at the discharge end and the plate shall be bolted to the flanges on the trough.

O. PIVOT FOOT - A telescopic supporting foot shall be provided to allow for the unit to be removed from the channel and allow for maintenance operations to be performed.

P. Compactor section located at the discharge end of the auger shall provide up to 40% reduction in screenings volume. A drainage tube shall be connected from the compaction area and discharge back into the trough.

Q. Spray wash systems to be provided in screen area, and transport tube. The system shall consist of a single solenoid valve and spray header mounted to the screen. Water requirements are a minimum of 15 GPM at 35 psi.

2.4 MANUALLY CLEANED COARSE BAR SCREEN

A. A manually cleaned bar screen with a maximum bar spacing of 3/4" (20 mm) shall be provided as a backup screen to the automatic fine screen, as shown on the drawings. The screen shall be capable of passing a peak flow rate of 2.5 MGD. Dimensions shall be as shown on the drawings.

2.5 GRIT CHAMBER EQUIPMENT

A. Paddles

1. Adjustable grit scouring intensity.
2. Four blades.
3. Material: 304 stainless steel.

B. Propeller Drive Tube:

1. Driven by large, totally enclosed spur gear and turntable bearing.
2. Dia: 10-3/4 in. minimum.
3. Material: 304 stainless steel.

C. Grit Fluidizer

1. Bolted to propeller drive tube.
2. Within 6" of pump suction inlet.
3. Helical configuration.

D. Propeller Drive Unit (Gear Motor and Gear Head):

1. Motor:
   a. Helical gear type.
   b. 1hp, 230/460 v, 3-ph, 60 Hz. explosion proof
   c. Steel housing and frame.
   d. Service Factor: 2.0 or greater on reducer, 1.15 on motor.

2. Gears:
   a. Alloy steel, heat treated, and hardened.
   b. Teeth: Hobbed and flame hardened.
   c. Helical Gears: Oil lubricated.
   d. Spur Tooth Bull Gear: Large, driven by pinion mounted on output shaft of helical

gear motor, enclosed in heavy cast iron case.
e. Spur Gear Pinion: Cut from heat-treated steel.
f. Bull Gear: Rotate with minimum 21-in. diameter turntable bearing.
g. Service Factor for Pinion and Bull Gear: 5 or greater at standard operating speeds.

3. Bull Gear Box:
   a. Specifically designed for this service.
   b. Provide opening for propeller drive table.
   c. Seal with air bell at bottom opening around drive tube.
   d. Provide bolted flanged connection at top for grit pump suction.

4. General Requirements:
   a. Maximum Drive Output Speed: 21 rpm.
   b. Suitable for continuous (24 hrs/day year round) service.
   c. Bearings shall have minimum B-10 bearing life of 50,000 hrs., except 21” diameter turntable bearing which shall have minimum B-10 life of 20 years.

E. Grit well cover plates

1. Maximum 3" opening between cover plate and propeller drive tube.
2. Two-piece with lifting loops.
3. Stationary, not part of rotating assembly.
4. Material: 304 stainless steel.

F. Flow Control Baffle:

1. Integral flow control baffle for both the inlet and outlet of the main chamber.
2. Material: 304 stainless steel.
3. Fabricate to dimensions as shown on Drawings.
4. No additional downstream flow control device shall be required to keep inlet channel velocity between 3.5 ft/s and 1.6 ft/s.
5. It shall be designed to direct the inlet flow into the chamber in a manner ensuring the proper vortex flow and to prevent short-circuiting.
6. It shall direct the flow out of the unit, and to act as a “slice weir” to control the water level in the main chamber and in the inlet channel.

2.5 GRIT PUMP (250 GPM)

A. Pump:

1. Centrifugal, vertical configuration.
2. Close-coupled.
3. Recessed Ni-Hard impeller.
4. Construction: Ni-hard especially designed for use of mechanical seals and vacuum priming.
5. Size: 4” suction, 4” discharge.
6. Capable of passing 4” sphere.
7. Capacity: 250 GPM.
8. One piece motor adapter/backhead.

B. Motor:

1. 5 HP, 1800 RPM, 230/460 Volt, 3 phase, 60 hertz explosion-proof.

2. Minimum 1-7/8" shaft diameter.
3. Solid stainless steel shaft through mechanical seal.
4. 6" maximum lower bearing to impeller distance.
5. Class F insulation, Class B temperature rise, 1.15, unless explosion-proof or VFD duty then 1.0 service factor.

2.6 CENTRIFUGAL GRIT CONCENTRATOR (250 GPM)

A. Mount grit concentrator on grit dewatering screw as recommended by manufacturer.

B. Size, capacity, and range of operation shall be compatible with total grit removal system as described herein.

C. Operates on the constant rate vortex principle.

D. Purpose: Remove water and organics from mixture of grit, water, and organics (pumped by grit pump) prior to grit dewatering screw, thereby minimizing hydraulic load.

E. Flow Pattern:

1. Pumped flow enters tangentially through side.
2. Grit and small volume of water exit out bottom into hopper of dewatering screw.
3. Organic material and rest of water exit out top to drain.
4. Minimum 93% removal of influent water and 95% removal influent organics.
5. Less than 5% putrescible material in recovered grit from underflow.

F. Top Section: Entire piece shall be high nickel iron coated with minimum 6 mil dry film thickness epoxy resin. Minimum thickness shall be 1/2". High wear areas thickness shall be 3/4".

G. Lower Materials: Minimum thickness of 3/4" Ni-Hard high nickel iron. Unit shall be coated with minimum 6 mil dry film thickness epoxy resin. Unit with replaceable liners or steel bodies shall not be allowed.

H. No moving parts; operates totally on hydraulic principles. Cyclones that rely on steel support body and replaceable

2.7 DEWATERING SCREW GRIT CONVEYOR (for 250 GPM)

A. General:

1. Provide inlet hopper to receive mixture of grit and water, sufficiently large to allow grit to settle out of water.
2. Provide 4” overflow in inlet hopper.
3. Provide unit as freestanding with support legs to hold conveyor at approximately 22° angle from horizontal.
4. Drive screw conveyor with gear motor mounted on discharge end.

B. Construction:

1. Screw:
   a. Diameter: 9 in.

b. Length: 15 ft.
c. Material: 304 stainless steel.

2. Screw Bearings:
   a. Outlet End: Anti-friction type.
   b. Inlet End: Greaseable bronze bushing.

3. Screw Trough:
   a. Material: 304 stainless steel
   b. Open 3/16” steel formed, U-shaped.
   c. Provide 2” diameter drain at inlet end.
   d. Provide 8” outlet.
   e. Provide 5'-1/4" of clearance between centerline of support legs and centerline of discharge.

4. Inlet Hopper:
   a. Material: 304 stainless steel.
   b. Overflow: Full-length, double-sided outlet weir trough with 4-in. flange.
   c. Slope three sides of hopper at least 50 degrees to horizontal.
   d. Projected Surface Area: 15.1 sq. ft.
   e. Parallel plates to improve retention of fine grit.

5. Drive:
   a. Provide belt driven shaft mounted helical gear reducer.
   b. Mount on plate bolted to flanges of screw trough at discharge end.

6. Motor:
   a. 1 hp, 230/460 v, 3-ph, 60 Hz. explosion proof

7. Cover:
   a. Material: 304 stainless steel
   b. Expanded steel flattened mesh cover over hopper and trough openings.
   c. Style designation: No. 13-15.
   d. Opening under concentrator not covered to allow incoming flow to enter unit.

8. Automatic Spring Loaded Lubricator:
   a. Unit relies on the movement of the bushing to pull grease from the refillable reservoir to the bushing surface.
   b. The reservoir and base shall be constructed of clear polycarbonate, which allows for visual inspection.
   c. The thread size is 1/8” NPT.
   d. Capacity: 6 oz. (178 cc).
   e. Size: 3” (75 mm) diameter x 6” (150 mm) tall.
   f. Operating Temperature Range: -10°F (-23°C) to 250°F (121°C).

2.9 ACCESS PLATFORMS

A. Two (2) 3' 0" (0.9 m) wide access platforms shall be provided. One (1) platform shall span the entire width of the grit chamber as shown on the drawings. This platform will provide access to the drive and motor. One (1) platform shall provide access to the inlet trough, manual bar screen, slide gate, fine screen, grit washer drive and motor. The platforms shall be capable of supporting a live load of 150 lbs. per linear foot (223 kg/m), in addition to the dead load. Deflection shall not exceed 1/360 of the unsupported span. A 42" (1067 mm) high handrail

and a midrail shall be provided for both sides of the platform. Openings shall be provided for transition to the platforms. Bar grating shall be aluminum and shall extend over the entire length of the screenings platform. Handrail and ladders shall be aluminum.

2.10 SHOP PAINTING

A. Surface Preparation

1. All structural steel surfaces shot blasted with steel grit.
2. Weld splatter and surface roughness removed by grinding.
3. Comply with SSPC-SP6 specifications.

B. Coating - Grit Mechanism

1. Single, 3 mil DFT primer - shop applied.

C. Coating - Concentrator and Conveyor

1. Single, 6 mil DFT, **VERSAPOX®** epoxy resin.

2.11 ELECTRICAL CONTROLS FOR AUTOMATIC OPERATION

A. Panel

1. NEMA 4X.
2. Panel shall be remotely mounted. Skid shall have NEMA 7 junction box and be prewired to all skid components from this point.
3. All components within the control panel shall be UL listed or recognized, and the complete grit system control panel itself shall be labeled as a UL 508A General Use Industrial Control Panel.
4. To facilitate wire tracing and servicing, the control wiring shall be run in enclosed wireways, with removable covers, rather than tied up in bundles.
5. Control relays up to 6-amp capacity shall be the modular, plug-in type, with integral LED indicating lights to show activation. Larger control relays shall be enclosed to be “finger safe”.
6. A duplex GFI protected convenience outlet shall be provided in the panel for operation of 120-volt AC devices.

B. Circuit Breakers

1. Thermal magnetic air circuit breakers shall be provided for branch disconnect service and short-circuit protection of all auxiliary circuits
2. Thermal magnetic circuit breakers with lockout capability shall be provided for each drive and pump motor, matched to the motor inrush current.

C. Starters

1. Magnetic across-the-line starters with 24-volt coils and solid-state overload protection for each phase shall be provided for each motor to give positive protection against phase unbalance, thermal overload, phase loss and ground fault.
2. To provide the fastest trip speed and for ground fault protection, only solid-state overload protection will be used, and motor starters using heater coils will not be acceptable.
3. Each single-phase auxiliary motor shall be equipped with an over-current protection

device in addition to the branch circuit breaker, or shall be impedance protected.

4. Include for following motors:
   a. Paddle drive.
   b. Grit pump.
   c. Screw conveyor.
5. Individual NEMA 7 Hand-Off-Automatic selector switches shall be provided for the pump and dewatering device drives.

D. Control Devices

1. 3 HOA shall be provided for control the screen, pump / dewatering, and drive.
2. An On Off selector switch shall be provided to operate the propeller drive motor starter.
3. To control the operation of the grit removal and dewatering system, and monitor the control, environmental and alarm functions, a specially preprogrammed, dedicated microprocessor-based control system shall be provided.
4. The PLC shall be an Allen Bradley MicroLogix 1400.
5. The controller shall interface with the panel display unit, motor starters, accessories and alarm functions through digital and analog input and output ports as required.
6. The digital controls shall operate on 24 volts or less, to eliminate shock hazard.
7. The 24-volt DC power supply shall be overload protected to be “crowbar safe” and will return to operation when a short is removed.
8. Program integrity shall be maintained by battery-backed RAM.
9. A surge suppressor with power filter shall be provided for the control circuits.
10. A NEMA 4X rated display unit shall be mounted through the front of the panel to provide operator input to and visual output from the microprocessor controller.
11. This interface shall be a 7” wide screen graphic interface with DSTN 65K-color Liquid Crystal Display with backlighting and resistive-type touch screen, for data input and programming.
12. The display shall have a “sleep” feature to prolong screen life.
13. A minimum of 11 (eleven) menu screens shall be available for display and management of paddle drive, grit pump and grit screw conveyor (optional) functions including, but not limited to:

E. Menu Screens screens shall be available for display and management of grit system control functions listed below:

1. Display Functions:
   a. Graphical motor running indication
   b. General alarm indication
   c. Individual alarm indicators for each alarm function (with time and date)
   d. Paddle drive run time
   e. Grit pump run time
   f. Grit screw conveyor run time
   g. Alarm silencing
   h. Date & time indication with set time functionality
   i. I/O status for trouble shooting
   j. Schedule maintenance items
   k. “Help” screens
2. Field Programming Functions:
   a. Select English or Spanish language display mode
   b. Grit removal schedule or return to default settings
   c. Grit pump run time or return to default settings
   d. Silence audible alarm
   e. Reset running time meters
   f. Set date/time

PART 3 EXECUTION

3.1 INSTALLATION

A. Installation of the grit equipment shall be in complete accordance with the manufacturer's instructions and recommendations, and the reviewed shop drawings.

1. Sealed conduit / seal off fitting will be shipped loose for final installation on classifier and screen; installation is by others and not included.
2. Prior to start up, file a certificate of proper installation in accordance with Section 01 75 16 Startup Procedures.

END OF SECTION