

**R-009-204.19**

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**SPECIFICATION NO. 02902-4502 CERTIFIED FOR  
CONSTRUCTION SOUTH GROUNDWATER  
CONTAMINATION PLUME FOR SOUTH PLUME  
GROUNDWATER TREATMENT (WBS 1.1.2.4.04.02)**

**01/15/92**

**AM KINNEY/WEMCO**

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**ENCLOSURE**

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SPECIFICATION NO. 02902-4502

CERTIFIED FOR CONSTRUCTION

SOUTH GROUNDWATER CONTAMINATION PLUME

FOR

SOUTH PLUME GROUNDWATER TREATMENT

(WBS 1.1.2.4.04.02)

Prepared for

Westinghouse Environmental Management Company of Ohio  
Fernald Environmental Management Project  
Fernald, Ohio

Contract No. N-77207

January 15, 1992

Prepared by

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CONSULTING ENGINEERS  
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SPECIFICATION NO. 02902-4502

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FOR  
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(WBS 1.1.2.4.04.02)

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END OF SECTION

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SECTION 00004

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18A-4445-X-01083	X-1	Cover Sheet	0	12-20-91
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18A-4445-E-01100	E-2	Not Used		
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18A-4445-E-01104	E-6	SWRB Valve House Electrical - Single Line Diagram and Site Plan	0	12-20-91
18A-4445-E-01105	E-7	SWRB Valve House Power, Lighting and Instrument Plans	0	12-20-91
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18A-4445-E-01108	L-1	Mechanical Legend	0	12-20-91
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18A-4445-E-01111	P-3	Not Used		
18A-4445-E-01112	P-4	Not Used		
18A-4445-E-01113	P-5	Equipment and Piping Layout - SWRB Valve House Plan and Sections	0	12-20-91
18A-4445-E-01114	P-6	Equipment and Piping Layout SWRB Transfer Station Plan and Sections	0	12-20-91
18A-4445-E-01115	P-7	Piping Details	0	12-20-91
18A-4445-E-01116	FP-1	Fire Protection Floor Plan	0	12-20-91
18A-4445-E-01117	I-1	Logic Diagrams	0	12-20-91
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SECTION 01100

GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. These General Requirements form a part of all the technical sections of these specifications.
- B. Identification:
  - 1. A. M. Kinney, Inc. prepared these performance specifications. In all cases where the word "Engineers" appears in these specifications, it shall be understood to refer to A. M. Kinney, Inc., or to such other individuals or organizations acting within the scope of the specific duties entrusted to them.
  - 2. In all cases where the terms "Vendor" or "Seller" or "Manufacturer" or similar terms appear in these specifications or in the appendices to these specifications, they shall be understood to refer to an individual or firm(s) providing materials, equipment, or services, as noted, under a sub-subcontract to the Subcontractor.
  - 3. In all cases where the words "Operating Contractor" appear, they shall be understood to refer to the FEMP Operating Contractor, The Westinghouse Environmental Management Company of Ohio.
  - 4. In all cases where the words "Construction Manager" appear, they shall be understood to refer to the FEMP Construction Manager, the Rust Engineering Company.
  - 5. In all cases where the word "Others" appears, it shall be understood to refer to firms other than the Subcontractor doing related work on the site.
- C. All work shall be accomplished in accordance with the requirements of the Ohio Basic Building Code, the Uniform Building Code (including requirements for seismic construction, Zone 2), and in accordance with the requirements of 29 CFR 1926 (OSHA) and 29 CFR 1910 (OSHA).

1.2 SCOPE OF WORK

- A. The Subcontractor shall provide all material, equipment and services to provide a pumping and valving system to remove water from the aquifer south of the Fernald Environmental Management Project (FEMP) and FEMP Storm Water Retention Basin (SWRB) and after treatment a discharge outfall system.
  - 1. The work in this subproject is designated as construction bid package 2A and includes:
    - a. Force main from future extraction wells to valve house.
    - b. Valvehouse, valving and pipe stubouts for future connections.
    - c. Force main piping system from the valvehouse to , and including, Manhole 176 B.

- d. Stormwater retention basin transfer pump system and piping system to Valvehouse.
  - e. Outfall gravity piping system from and including Manhole 176B to and including Manhole 182B near the Great Miami River.
2. Work not in this subproject to be part of a separate subproject includes:
- a. Construction of the outfall to the Great Miami River from Manhole 182B - Construction Bid Package 2B.
  - b. Recovery well field and well field piping, and aeration system - Construction Bid Package 2C.
- B. The Subcontractor shall perform all construction acceptance tests as coordinated and supervised by the Construction Manager and witnessed by the Operating Contractor. In addition, before the final acceptance of the work, the Subcontractor shall perform an integrated system construction acceptance test as coordinated and supervised by the Construction Manager and witnessed by the Operating Contractor.
- C. The Subcontractor shall provide written procedures for the Construction Manager's review and approval of all tests to be performed as identified in the Subcontractor's final design drawings and specifications. These procedures shall provide detailed step by step operations with sign-off columns and shall be submitted and approved at least 30 days prior to testing.
- D. All field test instruments shall have been calibrated within the last 12 months prior to use on this subcontract by a calibration laboratory whose calibration equipment and instruments are fully traceable to NIST standards. The Subcontractor shall provide individual certification of calibration and NIST standards traceability for all field test instruments used on this subcontract.
- E. Provide all field labor and other assistance required by the Operating Contractor or Construction Manager during any on-site field inspections being performed by the Operating Contractor or Construction Manager.
- F. Provide training of personnel required by CERCLA OSHA 29 CFR 1910.120 in accordance with Fernald Environmental Management Project procedures. The Subcontractor shall pay for training, observations, and employee time. WEMCO will pay only the cost of "Baseline Physicals".

### 1.3 CONTAMINATED MATERIALS

- A. All contaminated materials resulting from the demolition operations or cutting and patching operations under this specification are to be boxed as specified in FEMP-720. Minimum of two hours notification to be given to quality assurance for inspection of waste packaging. Quality assurance to be notified before and after completion of packaging.
- B. For heavy waste materials such as soil and concrete, the Operating Contractor will furnish 38 inch high by 52 inch wide by 76 inch long (inside dimension) containers at the construction site and will remove such containers from the construction site after they have been filled.

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- C. For lighter waste materials such as wood and scrap metal, the Operating Contractor will furnish "land/sea container" at the construction site, with nominal inside dimension of 7-1/2 feet by 7-1/2 feet by 19 feet and will remove such containers from the construction site after they have been filled by the subcontractor as per the current issue of the applicable WEMCO standard operating procedure (SOP 1-C-602).
- D. The subcontractor shall size reduce waste materials as required to fit in such boxes.

1.4 UTILITY OUTAGES

- A. All work requiring utility outages or system shutdowns shall be performed on weekends.

1.5 SPECIFICATION EXPLANATION

- A. The technical specifications are of the abbreviated, simplified or streamlined type and include incomplete sentences. Omissions of words or phrases such as "the Subcontractor shall," in conformity therewith, "shall be," "as noted on the drawings," "according to the plans," "a," "the," and "all" are intentional omitted words or phrases shall be supplied by inference in the same manner as they are when a "note" occurs on the drawings.
- B. The Subcontractor shall provide all items, articles, materials, operations or methods listed, mentioned, or scheduled either on the drawings, or specified herein, or both, including all labor, materials, equipment and incidentals necessary and required for their completion and installation.
- C. For convenience of reference and to facilitate the letting of sub- subcontracts, the specifications may be separated into titled divisions. Such separations, however, shall not operate to make the Engineers arbitrators to establish the limits of subcontracts in any manner.
- D. Definitions: Certain terms and words as used throughout the specifications shall be defined as follows, unless otherwise particularly specified:

<u>Term</u>	<u>Definition</u>
1. Indicated:	As shown on the drawings and/or specified.
2. Directed Authorized, or Permitted.	As directed, authorized, or permitted by the Construction Manager.
3. Satisfactory or Acceptable:	Satisfactory or acceptable to the Operating Contractor.
4. Necessary, required, or suitable:	As necessary, required, or suitable for the intended purpose as determined by the Construction Manager.

5. Submit: Submit to the Construction Manager unless otherwise specified.
6. In all cases where the words "or equal" appear in these specifications, they shall be understood to mean "or approved equal."
7. The following list denotes abbreviations used in the technical portions of these specifications:

Abbreviations

Authority

AAMA	Architectural Aluminum Manufacturers Association
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
ACPA	American Concrete Pipe Association
AIMA	Acoustical and Insulating Materials Association
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
ANSI	American National Standards Institute
APA	American Plywood Association
ARA	American Railway Association
A.R.E.A.	American Railway Engineering Association
ARI	Air Conditioning and Refrigeration Institute
ARMA	Asphalt Roofing Manufacturers Association
ASAHC	American Society of Architectural Hardware Consultants
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWPA	American Wood Preservers Association
AWPI	American Wood Preservers Institute
AWS	American Welding Society
AWWA	American Water Works Association
BIA	Brick Institute of America
CRSI	Concrete Reinforcing Steel Institute
GA	Gypsum Association
HPMA	Hardwood Plywood Manufacturers Association
IEEE	Institute of Electrical and Electronics Engineers
ILIA	Indiana Limestone Institute of America
LIA	Lead Industries Association
MBMA	Metal Building Manufacturers Association
MLA	Metal Lath Association
NAAMM	National Association of Architectural Metal Manufacturers
NBHA	National Builders Hardware Association
NIST(NBS)	National Institute for Standards and Technology (formerly National Bureau of Standards)
NCMA	National Concrete Masonry Association
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association

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Abbreviations

Authority

NLA	National Lime Association
NRCA	National Roofing Contractors Association
NRMCA	National Ready Mixed Concrete Association
PCA	Portland Cement Association
PCI	Prestressed Concrete Institute
SDI	Steel Deck Institute
SJI	Steel Joist Institute
SSPC	Steel Structures Painting Council
UL	Underwriters Laboratories Inc.

1.6 SUBMITTALS

- A. Article SC-24 of the "Rust Special Terms and Conditions" shall be supplemented by the following (any submittals not in conforming to these requirements will be returned without review for correction and resubmittal):
- B. Submittals for unrelated items shall not be included in the same transmittal. Each separate submittal shall be coordinated and shall include all drawings and data required for the item or system covered.
- C. Submittals shall indicate project name and Engineers' specification number (if pages are securely bound in a brochure, this is needed on the cover only) and identification by specification division, section, subsection and article under which equipment or material is described, and by name, number and intended use as designated by CFC drawings and specifications.
- D. When more than one item of equipment is included on a single drawing or catalog cut, each project equipment item must be separately identified thereon, with clear delineation as to which model or catalog number or performance data applies to each project item.
- E. Assemble and submit, in logically arranged folders. All instruction bulletins, diagrams lubrication schedules, operating instructions, parts lists and pamphlets for equipment and apparatus furnished, including vendor's or manufacturer's recommended procedure for lifting, handling and installing equipment.
- F. The Engineers' review of such submittals shall not relieve the Subcontractor from any responsibility for deviations from contract documents, unless the Subcontractor has in writing called the Engineers' attention to such deviations at the time of submission, nor shall it relieve the Subcontractor from responsibility for errors of any sort in the submittals nor from responsibility for the proper fitting and construction of the work.
  1. Submittals will be reviewed with respect to such factors as quality of draftsmanship, legibility, and evidence that the Subcontractor is aware of the necessity and importance of adequately detailing and illustrating special features and conditions relating to the work. If the Engineers determine that the data submitted, in part or in whole, is not within the purview of their review, such submittal, or part thereof, will be returned unchecked. Dimensions, sizes, construction details, and directive notes shown will be reviewed for accuracy, compliance with the specifications, adequacy, interferences, etc., on a spot

- check or incomplete basis to establish that the Subcontractor has given such factors careful attention.
2. Any changes marked on submittals during review will be for the purpose of indicating the requirements of the contract documents and no change in the contract amount is authorized by such markings.
- G. When submittals are found to be satisfactory with respect to the above factors and within the scope of the review outlined above, they will be returned to the Subcontractor bearing certificate attachment permitting the Subcontractor to employ them in the furtherance of work under the contract, but only with the express understanding that such permission shall not relieve the Subcontractor of responsibilities for the full performance of the work required under the contract conforming to the contract documents governing such performance, nor for any other deficiencies in the submittals such as inaccuracies, discrepancies, omissions, interferences in the work itself, or with the work of other Subcontractors whether or not such deficiencies were observed or noted in the course of the review of the shop drawings.
- H. Submittal requirements: Submittals required include drawings and/or data for all items listed in the attached submittals listing; Refer technical divisions for more detailed requirements:

<u>Designations:</u>	<u>Requirements Description</u>
A	Shop drawings and pertinent performance data and curves.
B	Catalog data, and pertinent performance data and curves.
C	Items are to be included on a listing giving manufacturer and brief type description for each item. Listing shall be submitted not later than 30 days after notice to proceed. note that shop drawings or catalog data may also be required for items included on this list.
D	Samples of finishes with full range of color choices and/or patterns submitted.
E	Physical samples of materials.
F	Individual certifications for conformity to qualifications and standards specified. For equipment items, this indicates certified equipment drawings are to be submitted.
G	Technical specifications contain specific submittal requirements.
H	Engineering calculations.
I	Spare parts list.
J	Installation, operation and maintenance manual.
K	Manufacturer's material safety data sheets.
L	Test reports for tests noted in technical specifications.

- M Wiring diagrams for power, signal, and control wiring.
- N Schematic piping diagrams, with sizes and components shown.

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1.7 OPERATING MANUALS AND SPARE PARTS LISTS

- A. Copies of a priced recommended spare parts list shall be submitted at least 30 days prior to the shipment of any item of equipment.
- B. An installation, operation and maintenance (IOM) manual shall be prepared so as to provide optimum operation and maintenance of the equipment and systems being furnished.
- C. Cover of the IOM manuals shall include the following information:

Project Title	- SOUTH GROUNDWATER CONTAMINATION PLUME For SOUTH PLUME GROUNDWATER TREATMENT
W.B.S. NO.	- 1.1.2.4.04.02
Operating Contractor	- WESTINGHOUSE ENVIRONMENTAL MANAGEMENT COMPANY OF OHIO
Consulting Engineers	- A. M. KINNEY, INC.
Construction Manager	- THE RUST ENGINEERING COMPANY
Subcontractor	- (Name of subcontractor)
Consulting Engineer's Specification No.	- 02902-4502

- D. The IOM manuals shall be bound into one or more volumes for ease of handling and shall have an index. The manual shall include descriptive literature, drawings, performance curves and rating data, test reports and spare parts lists. The maintenance section shall divide maintenance procedures into two categories, "preventive maintenance" and "corrective maintenance" and subsection for "safety precautions." Preventive maintenance shall include cleaning, and adjustment instructions. Corrective maintenance shall include instructions and data arranged in the normal sequence of corrective maintenance, i.e., troubleshooting (logical effect to cause), then repair and replacement of parts, then the parts list. Safety precautions shall comprise a list of safety precautions and instructions to be followed before, during and after making repairs, adjustments, or routine maintenance.
- E. Submit complete sets of final, approved manuals no later than 30 days prior to the shipment of the equipment or system.

1.8 CODES AND STANDARDS

- A. In addition to codes and standards referenced in the technical divisions of these performance specifications, all work, and the completed project, shall comply with the latest editions of the following at the time of final offer:
1. All applicable federal and State of Ohio codes, laws and regulations.
  2. Ohio Basic Building Code (OBBC), including requirements for seismic Zone 2.
  3. 29 CFR 1926 (OSHA).
  4. 29 CFR 1910 (OSHA).
  5. DOE 6430.1A General Design Criteria.
  6. FEMP-720, Control of Construction Waste.
  7. FEMP-2128.
  8. WEMCO Standard Operating Procedure SOP-1-C-602.
  9. Comprehensive Environmental Response, Compensation, and Liability Act/Superfund Amendments and Reauthorization act (CERCLA/SARA).
  10. Great Lakes - Upper Mississippi River Board of State Sanitary Engineers Recommended Standards for Sewage Works.
  11. FEMP - Work Permit Procedures.
  12. Westinghouse Environmental Management Company of Ohio - Industrial Hygiene and Safety Manual "Control of Entering and/or Working in Confined Spaces".
- B. At the completion of the project, the Subcontractor shall submit to the Construction Manager a statement certifying that the completed project complies with all such referenced codes and standards.

1.9 CLEANING UP

- A. Article A-26 of the Rust "General Terms and Conditions" shall be supplemented by the following:
1. The Subcontractor shall, upon completion and acceptance of the work, turn over to the Operating Contractor all permanent work furnished and performed under this subcontract in a thoroughly cleaned and workmanlike condition, free from any dirt, grit, oil, paint, and other forms of soilage, and ready for the Operating Contractor's use in every respect.

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1.10 COST BREAKDOWN

- A. As part of the Subcontractor's responsibilities under Article A.14 of the Rust General Terms and Conditions with design, the Subcontractor shall, within 10 days after notice to proceed, submit a cost breakdown allocating the total contract amount into the various categories shown on Attachment No. 2 to this section. This cost breakdown is for the use of the Operating Contractor, and is in addition to the cost breakdown submitted with the initial proposal, and in addition to any cost breakdown requested by the Construction Manager for payment request purposes. Attachment No. 2 shall not be used for invoicing purposes.

END OF SECTION

ATTACHMENT NO. 2 TO SECTION 01100

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Cost Breakdown for Estimate Reconciliation

<u>Item No.</u>	<u>Cost/Contract Item</u>	<u>Labor and Materials Total Per Item</u>
1.	Mechanical - Prime and General Conditions	\$ _____
2.	General Construction	\$ _____
3.	Structural Metals	\$ _____
4.	Seeding	\$ _____
5.	Masonry	\$ _____
6.	Painting	\$ _____
7.	Electrical	\$ _____
8.	Instrumentation	\$ _____
		_____
	<b>Total Contract Amount</b>	<b>\$ _____</b>

1. Breakdown must equal the Subcontractor's total contract amount. contingency, escalation, overhead, profit and bonding shall be proportionately spread among the items.
2. Items 2 through 8 are considered as sub-subcontractors under item 1. Any additional sub-subcontractors not shown are to be included with item 1. any additional levels of sub-subcontracting not shown are to be included with the level immediately above.

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SECTION 02070

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SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Removal of designated portions of existing structures required to accommodate new construction including, but not limited to:
  - a. Remove steel beams from exterior pump pit.
  - b. Remove steel ladder from exterior pump pit.
  - c. Remove FRP floor grating from exterior pump pit.
  - d. Remove portion of existing fence.
  - e. Remove several pipe culverts.
  - f. Open cut roadways.
2. Removal, storage and protection of existing items to be salvaged.
3. Removal, temporary storage and subsequent offsite disposal.
4. Provide coordination required so that any utilities to be removed are disconnected before demolition is started.

B. Related Work In Other Sections:

1. Specific requirements for reinstallation work and patching are specified in respective sections of specifications.
2. Cutting and patching.
3. Removal of pipes, conduits, ducts, electrical fixtures, fans and other mechanical and electrical work.
4. Reconditioning and installation of salvaged items in new work.

1.2 DESCRIPTIONS

A. Items to be salvaged for reuse.

- 1 Steel ladder.

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2. Fencing.

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1.3 SUBMITTALS

- A. Schedule: Prior to commencing work, submit sequence of demolition operations.
- B. Operations methods for:
  - 1. Dust and noise control.
  - 2. Maintaining continuing operations.

1.4 JOB CONDITIONS

- A. Occupancy: FEMP will continuously occupy areas adjacent to areas of demolition area. Conduct work to minimize disruption of FEMP normal operations. Notify Construction Manager 72 hours advance of any demolition activities which interfere with FEMP normal operations.
- B. Existing Conditions: Maintain adequacy of structure during demolition. Construction Manager is not responsible for actual condition of work to be demolished.
- C. Damages: Promptly repair damages caused to adjacent facilities by demolition work at no cost to FEMP.
- D. Traffic:
  - 1. Conduct demolition and debris removal with minimum interference to roads, streets, walks, and adjacent facilities.
  - 2. Do not obstruct streets, walks or other occupied or used facilities. Provide alternate routes around closed or obstructed traffic ways.
- E. Explosives:
  - 1. Use of explosives is not permitted.
- F. Fire Safety: Do not use flame cutting or other flame tools without FEMP work permit. If permitted provide and maintain fire extinguishing equipment as required.
- G. Environmental Controls: Limit dust and dirt rising and scattering in air to lowest practical level. Comply with all governing regulations pertaining to environmental protection.
  - 1. Do not use water when it may create ice, flooding, pollution or other hazardous conditions.
  - 2. If dirt or dust from demolition becomes excessive, the Construction Manager reserves the right to deduct the cost of cleanup by others from the work.

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- H. **Utility Services:** Maintain existing utilities required to remain, keep in service, and protect against damage during demolition operations.
    - 1. Maintain existing utilities service to occupied facilities, except when authorized in writing by the Construction Manager.
  - I. **Protection:** Provide temporary warning signs, barricades and other forms of protection as required to protect existing construction and equipment, vehicular traffic, FEMP personnel and public from injury and damage from demolition operations.
    - 1. Provide for free and safe passage of Construction Manager, FEMP and other authorized personnel and general public within demolition areas of building.
    - 2. Provide shoring, bracing, or support to prevent movement, settlement, or collapse of structure, work under demolition, or adjacent work to remain.
    - 3. Protect from damage existing finish work that is to remain in place and becomes exposed during demolition operations.
    - 4. Protect floors, walls, and other surfaces with suitable coverings when necessary.

#### 1.5 SEQUENCING AND SCHEDULING

- A. Coordinate demolition with FEMP operations at existing structures.
- B. Coordinate work with other trades. Afford them reasonable opportunity to remove and disconnect work associated with their operations.
- C. Perform all work that disrupts operations as directed by Construction Manager.

#### PART 2 - PRODUCTS (Not Applicable).

#### PART 3 - EXECUTION

##### 3.1 INSPECTION

- A. Inspect area of work, prior to demolishing it. Notify Construction Manager in writing of any conditions which could be misconstrued as damage resulting from demolition work.

##### 3.2 PREPARATION

- A. Provide shoring, bracing, or support to prevent movement, settlement or collapse of structures to be demolished and adjacent facilities to remain. Subcontractor is responsible for the structural adequacy of his work.
  - 1. If safety of structures appears to be endangered, immediately support structure until determination is made for continuing operations.
- B. Protect from soiling or damage equipment, fixtures and other items that remain in areas under demolition.

### 3.3 DEMOLITION

- A. Notify Construction Manager in writing of unanticipated conflicts. Rearrange demolition schedule to continue overall job progress without delay.
- B. Structural Steel and Miscellaneous Metal: Disconnect at joints where possible. Flame cuts to equal appearance of sheared section when permitted. Lower members or sections to ground by suitable method. Obtain FEMP work permit before welding or flame cutting is started.
  - 1. Completely fill below-grade areas and voids resulting from demolition work. Provide fill consisting of approved earth, gravel or sand, free of trash and debris, stones over 6" diameter, roots or other organic matter.

### 3.4 SALVAGE MATERIALS

- A. Salvage for reuse: Carefully remove items, clean, and store for reinstallation. Contractor is responsible for damage not identified to the Construction Manager prior to removal.

### 3.5 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove debris, rubbish and other materials resulting from demolition operations from building site on a daily basis. Transport and legally dispose of materials off site.
  - 1. If hazardous materials are encountered during demolition operations, comply with applicable regulations, laws, and ordinances concerning removal, handling and protection against exposure or environmental pollution, including asbestos removal.
  - 2. Burning of removed materials is not permitted on project site.
- B. Subcontractor's Salvage: Remove items not salvaged for reuse from site as they are removed. Storage or sale of removed items on site will not be permitted.

### 3.6 CLEANUP AND REPAIR

- A. Upon completion of demolition remove equipment and demolished materials from site.
- B. Repair accidental damage. Return remaining structures and surfaces to original condition. Repair adjacent construction or surfaces soiled or damaged by selective demolition work.

END OF SECTION

SECTION 02200

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EARTHWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Clearing and Grubbing.
2. Rough Grading for building and site work.
3. Removal of paving materials as necessary for new work.
4. Strip ground surfaces within grading area to depths as necessary to remove existing topsoil but in no event less than 6 inches.
5. Excavation and backfill for building and structural foundations.
6. Finish grades for slabs on grade and foundations.
7. Granular base course for support of building slab.
8. Erosion Control.

B. Related Work In Other Sections:

1. Excavating and backfilling for utility trenches, underground mechanical and electrical utilities and buried mechanical and electrical appurtenances.
2. Finish Site Grading.
3. Subgrade preparation, subbases and bases for pavement.
4. Topsoil and grass.
5. Submittal Requirements.

1.2 DEFINITIONS

- A. Excavation consists of removal of material encountered to subgrade elevations indicated and subsequent disposal of materials removed.

**B.** Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction of Construction Manager. Unauthorized excavation, as well as remedial work directed by Construction Manager, shall be at subcontractor's expense.

1. Under footings, or foundation bases, fill unauthorized excavation by extending indicated bottom elevation of footing or base to excavation bottom, without altering required top elevation. Lean concrete fill may be used to bring elevations to proper position, when acceptable to Construction Manager.
  2. In locations other than those above, backfill and compact unauthorized excavations as specified for authorized excavations of same classification, unless otherwise directed by Construction Manager.
- C.** Additional Excavation: When excavation has reached required subgrade elevations, notify Construction Manager, who will make an inspection of conditions. If Construction Manager determines that bearing materials at required subgrade elevations are unsuitable, continue excavation until suitable bearing materials are encountered and replace excavated material as directed by Construction Manager.
1. Excavation is unclassified and includes excavation to subgrade elevations indicated, regardless of character of materials and obstructions encountered.
  2. Provided the Construction Manager has the opportunity to document the quantity of any additional excavation beyond subgrades indicated, the Contract Sum will be adjusted by an appropriate Contract Modification.
  3. The Contract Sum may be adjusted by an appropriate Contract Modification.
  4. Removal of unsuitable material and its replacement as directed will be paid on basis of Conditions of the Contract relative to changes in work.
- D.** Subgrade: The undisturbed earth or the compacted soil layer immediately below granular base, or aggregate topping.
- E.** Structures: Buildings, foundations, slabs, or other man-made stationary features occurring above or below ground surface.

### 1.3 SUBMITTALS

- A.** Test Reports: Submit field density test reports directly to Construction Manager from the testing services, with copy to subcontractor.
- B.** Optimum moisture-maximum density curve: Submit one for each type of soil encountered.
- C.** Report of actual unconfined compressive strength and/or results of bearing tests: Submit for each strata tested.

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#### 1.4 QUALITY ASSURANCE

- A. Codes and Standards: Perform excavation work in compliance with applicable requirements of OSHA and the Ohio Basic Building Code.
- B. Testing and Inspection Service:
  - 1. Construction Manager will employ and pay for a qualified independent geotechnical testing and inspection laboratory to perform soil testing and inspection service during earthwork operations.
- C. Testing Laboratory Qualifications: To qualify for acceptance, the geotechnical testing laboratory must demonstrate to Construction Manager's satisfaction, based on evaluation of laboratory-submitted criteria conforming to ASTM E 699, that it has the experience and capability to conduct required field and laboratory geo-technical testing without delaying the progress of the Work.

#### 1.5 PROJECT CONDITIONS

- A. Test borings and other exploratory operations may be performed by subcontractor, at the subcontractor's option; however, no change in the Contract Sum will be authorized for such additional exploration.
- B. Existing Utilities: Locate existing underground utilities in areas of excavation work. If utilities are to remain in place, provide adequate means of support and protection during earthwork operations.
  - 1. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult utility owner immediately for directions. Cooperate with Operating Contractor and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility Operating Contractor.
  - 2. Do not interrupt existing utilities serving facilities occupied by Operating Contractor or others, during occupied hours, except when permitted in writing by Construction Manager and then only after acceptable temporary utility services have been provided.
    - a. Provide minimum of 48-hour notice to Construction Manager, and receive written notice to proceed, before interrupting any utility.
- C. Use of Explosives:
  - 1. Use of explosives is not permitted.
- D. Operate warning lights as recommended by authorities having jurisdiction.
- E. Protect structures, utilities, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. Satisfactory soil materials are defined as those complying with ASTM D2487 soil classification groups GW, GP, GM, SM, SW, and SP.
- B. Unsatisfactory soil materials are defined as those complying with ASTM D2487 soil classification groups GC, SC, ML, MH, CL, CH, OL, OH, and PT.
- C. Granular base: Washed, evenly graded mixture of crushed stone, or crushed or uncrushed gravel, with 100 percent passing a 1-1/2 inch sieve and not more than 5 percent passing a No. 4 sieve.
- D. Backfill and Fill Materials: Satisfactory soil materials free of clay, rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, vegetation and other deleterious matter.

PART 3 - EXECUTION

3.1 STABILITY OF EXCAVATIONS

- A. Comply with local codes, ordinances, and requirements of agencies having jurisdiction.
- B. Slope sides of excavations to comply with local codes, ordinances, and requirements of agencies having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated. Maintain sides and slopes of excavations in safe condition until completion of backfilling.
- C. Shoring and Bracing: Provide materials for shoring and bracing, such as sheet piling, uprights, stringers, and cross braces, in good serviceable condition. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Extend shoring and bracing as excavation progresses.
  - 1. Provide permanent steel sheet piling wherever subsequent removal of sheet piling might permit lateral movement of soil under adjacent structures. Cut off tops a minimum of 2'-6" below final grade and leave permanently in place.

3.2 DEWATERING

- A. Control grades to prevent surface water from flowing into excavations and from flooding project site and surrounding area.
  - 1. Do not allow water to accumulate in excavations. Remove water detrimental to stability of subgrades and foundations. Provide and maintain pumps, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.

2. Construct and maintain temporary drainage ditches and other diversions outside excavation limits to convey rain water and water removed from excavations to collecting or runoff areas. Do not use trench excavations as temporary drainage ditches.

- B. Should the subcontractor fail to promptly initiate dewatering procedures when directed, the right is reserved to have the work performed by others at subcontractor's expense.

### 3.3 DISPOSITION OF EXCAVATED MATERIALS

- A. Dispose of the following materials offsite:

1. Materials not acceptable for use as backfill or fill.

- B. Stockpiles: Deposit materials stockpiled for reuse in authorized locations on site and not above elevations authorized. Spread materials in a manner which will permit reuse. Slope and compact to prevent rainwash. Stock pile the following material for reuse:

1. Topsoil, not in excess of requirements.
2. Removed materials suitable for fill and backfill, not in excess of requirements.

- C. Spoil areas: Grade surfaces of materials placed in authorized spoil areas to ensure proper drainage away from such areas and so that water is not trapped on or behind such fills. Slope and compact as necessary to ensure against rainwash. Dispose of the following material in designated spoil areas.

1. Topsoil and Excavated Material: Place suitable excess material to elevations authorized and then cover with stockpiled topsoil evenly.

- D. Unauthorized placement: Promptly remove any spoil or stockpile materials placed in unauthorized locations or to unauthorized elevations. Should the subcontractor fail to remove such materials with reasonable promptness, the Construction Manager reserves the right to have such materials removed at Subcontractor's expense.

1. Locate and retain soil materials away from edge of excavations.

### 3.4 CLEARING AND GRUBBING

- A. Remove all existing miscellaneous materials encountered, including, but not limited to:

1. Exposed or buried debris.
2. Foundations.

- B. Vegetation: Remove from within the grading area existing vegetation. Grub the area, removing stumps and roots larger than 2 inches in diameter to a depth of 2 feet below finish grades.

- C. Pavements: Where portions of existing pavements are shown to remain or to form base of overlays, cut limit lines with acceptable power-driven saws to a depth not less than 4 inches and in straight lines before starting demolition and/or removal.

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### 3.5 EXCAVATION FOR STRUCTURES

- A. Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10 foot, and extending a sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services, and other construction and for inspection.
  - 1. Excavations for footings and foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed. Trim bottoms to required lines and grades to leave solid base to receive other work.

### 3.6 EXCAVATION FOR PAVEMENTS

- A. Cut surface under pavements to comply with cross-sections, elevations and subgrades.

### 3.7 BACKFILL AND FILL

- A. Soil subgrade material: Construct supporting subgrades using following materials for:
  - 1. Pavements: Subbase material, satisfactory excavated or borrow material.
  - 2. Interior slabs on grade: Granular base material.
- B. Backfill excavations as promptly as work permits, but not until completion of the following:
  - 1. Acceptance of construction below finish grade including, waterproofing.
  - 2. Inspection, testing, approval, and recording locations of underground utilities have been performed and recorded.
  - 3. Removal of concrete formwork.
  - 4. Removal of trash and debris from excavation.
  - 5. Temporary horizontal bracing is in place on horizontally supported walls.

### 3.9 PLACEMENT AND COMPACTION

- A. Place backfill materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- B. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification. Do not place backfill material on surfaces that are muddy, frozen, or contain frost or ice.
- C. Place backfill materials evenly adjacent to structures, piping, or conduit to required elevations. Prevent wedging action of backfill against structures or displacement of piping or conduit by carrying material uniformly around structure, piping, or conduit to approximately same elevation in each lift.

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- D. Control soil and fill compaction, providing minimum percentage of density specified for each area classification indicated below. Correct improperly compacted areas or lifts as directed by Construction Manager if soil density tests indicate inadequate compaction.
1. Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of maximum density, in accordance with ASTM D 698:
    - a. Under structures, building slabs and steps, and pavements, compact top 12 inches of subgrade and each layer of backfill or fill material at 95 percent maximum density.
    - b. Under unpaved areas, compact top 6 inches of subgrade and each layer of backfill or fill material at 90 percent maximum density.
  2. Moisture Control: Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade or layer of soil material. Apply water in minimum quantity as necessary to prevent free water from appearing on surface during or subsequent to compaction operations.
    - a. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density.
    - b. Stockpile or spread soil material that has been removed because it is too wet to permit compaction. Assist drying by discing, harrowing, or pulverizing until moisture content is reduced to a satisfactory value.

### 3.10 GRADING

- A. General: Uniformly grade areas within limits of grading under this section, including adjacent transition areas. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between points where elevations are indicated or between such points and existing grades.
- B. Grading Outside Building Lines: Grade areas adjacent to building lines to drain away from structures and to prevent ponding. Finish surfaces free from irregular surface changes and as follows:
  1. Unpaved Areas: Finish areas to receive topping to within not more than 0.10 foot above or below required subgrade elevations.
  2. Pavements: Shape surface of areas under pavement to line, grade, and cross-section, with finish surface not more than 1/2 inch above or below required subgrade elevation.
- C. Grading Surface of Fill under Building Slabs: Grade smooth and even, free of voids, compacted as specified, and to required elevation. Provide final grades within a tolerance of 1/2 inch when tested with a 10-foot straightedge.
- D. Compaction: After grading, compact subgrade surfaces to the depth and indicated percentage of maximum or relative density for each area classification.

### 3.11 BUILDING SLAB GRANULAR BASE

- A. General: Place of granular base material, in layer of indicated thickness, over subgrade surface to support concrete building slab.

### 3.12 FIELD QUALITY CONTROL

- A. Quality Control Testing During Construction: Allow testing service to inspect and approve each subgrade and fill layer before further backfill or construction work is performed.
  - 1. Perform field density tests in accordance with ASTM D 1556 (sand cone method) or ASTM D 2167 (rubber balloon method), as applicable.
    - a. Field density tests may also be performed by the nuclear method in accordance with ASTM D 2922, providing that calibration curves are periodically checked and adjusted to correlate to tests performed using ASTM D 1556. In conjunction with each density calibration check, check the calibration curves furnished with the moisture gages in accordance with ASTM D 3017.
    - b. If field tests are performed using nuclear methods, make calibration checks of both density and moisture gages at beginning of work, on each different type of material encountered, and at intervals as directed by the Construction Manager.
  - 2. Paved Areas and Building Slab Subgrade: Perform at least one field density test of subgrade for every 2,000 sq. ft. of paved area or building slab, but in no case fewer than three tests. In each compacted fill layer, perform one field density test for every 2,000 sq. ft. of overlaying building slab or paved area, but in no case fewer than three tests.
  - 3. Foundation Wall Backfill: Perform at least two field density tests at each location and elevation as directed.
  - 4. If in opinion of Construction Manager, based on testing service reports and inspection, subgrade or fills that have been placed are below specified density, perform additional compaction and testing until specified density is obtained.

### 3.13 EROSION CONTROL

- A. Provide erosion control methods in accordance with requirements of Operating Contractor.

### 3.14 MAINTENANCE

- A. Protection of Graded Areas: Protect newly graded areas from traffic and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades in settled, eroded, and rutted areas to specified tolerances.
- C. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, reshape, and compact to required density prior to further construction.

- D. **Settling:** Where settling is measurable or observable at excavated areas during general project warranty period, remove surface (pavement, grass, or other finish), add backfill material, compact, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

END OF SECTION

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SECTION 02300

CASINGS AND JACKING UNDER ROADS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Earthwork for jacking.
2. Jacking casing pipe under roads.
3. Casing pipe.

B. Related Work in Other Sections:

1. Utilities trenching and backfill.
2. Site clearing.

1.2 SUBMITTALS

- A. Plans and descriptions of jacking arrangement.

1.3 QUALITY ASSURANCE

A. Standards:

1. Owner will obtain necessary permit and construction requirements from Hamilton County and Ohio Department of Transportation. Perform work in compliance with requirements of the governing authority.

B. Testing and Inspection Service:

1. The Construction Manager will engage soil testing and inspection service for quality control testing during earthwork operations. Give testing and inspection service timely notice of readiness of the work for required tests and inspections.

- C. Qualifications: Provide at the site the full time services of both a field supervisor and a machine operator that have a minimum of 12 months experience in operating equipment being used.

1.4 SITE CONDITIONS

- A. Traffic: Conduct operations without interference with railroad, and streets traffic.

1. Notify Governing Authority of intended construction operations 2 weeks in advance of start date for construction.

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**B. Site Utilities:**

1. Locate existing underground utilities in areas of work. Should uncharted or incorrectly charted utilities be encountered, consult Construction Manager immediately for direction.
2. Electrically ground cranes or other equipment that is operating in vicinity of electrification and power transmission facilities.

**C. Blasting for excavation or boring will not be permitted.**

**PART 2 - PRODUCTS**

**2.1 MATERIALS**

**A. Casing Pipes: Carbon steel ASTM A 53, Grade B, beveled ends for field butt welding; size as indicated.**

1. Bituminous coat outside of pipe.

**B. Backfill materials:**

1. Free of clods and stones larger than 2 inches in any dimension.
2. Free of debris, waste, frozen materials, and organic and other deleterious matter.

**PART 3 - EXECUTION**

**3.1 PREPARATION**

**A. Barricade open excavations and post with warning lights as recommended by governing authorities.**

1. Provide protection where potential for injury to persons and damage to property is present.
2. Protect persons, utilities, sidewalks, pavements, and other facilities from injury or damage caused by settlement, lateral movement, undermining, washout, and other hazards created by operations under this section.
3. Provide and maintain sheeting, shoring, bracing, or other protective measures in compliance with applicable codes and ordinances. Carry down shoring and bracing as excavation progresses.

**3.2 EXCAVATION AND BACKFILL**

**A. Excavate to remove materials encountered in achieving subgrade elevations indicated and the subsequent reuse or disposal of materials removed.**

1. Over excavation: Under foundation base backfill and compact as specified for backfill.

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2. If unsuitable bearing materials are encountered at required subgrade elevations, carry excavations deeper, remove unsuitable materials, and replace with approved material as required by the Construction Manager.
  3. Removal and disposal of unsuitable material and its replacement as required will be paid on basis of contract conditions relative to changes in work.
- B. Stockpile materials to be used for filling and backfilling, including excavated materials classified as satisfactory soil materials, at locations as directed.
- C. Backfill excavations promptly as work permits.
1. Place approved backfill materials in layers to required elevations.
    - a. Maximum loose lift: 4 inches.
    - b. Minimum compaction: 95 percent standard proctor.

### 3.3 CASINGS

- A. Install casing pipes to line and grade indicated, using boring method. Furnish at earliest possible date, length, width, and depth required for pits to be used for boring.
- B. Construct casing pipe to prevent leakage of any substance from the casing throughout its length, except at ends of casing where ends are left open. Install casing to prevent the formation of fluids under the roads and with an even bearing through its length.
1. Exterior of field welded joints are to be field coated with an acceptable quick setting bituminous material.
- C. Push pipe into the ground with a boring auger rotating within the pipe to remove the spoil. When augers, or similar devices, are used for pipe emplacement, the front of the pipe to be provided with mechanical arrangements or devices that will positively prevent the auger and cutting head from leading the pipe so that there will be no unsupported excavation ahead of the pipe. The arrangement to be removable from within the pipe in the event an obstruction is encountered, excavation by the cutting head not to exceed the outside diameter of the pipe by more than 1/2 inch. Face of the cutting head to be arranged to provide reasonable obstruction to the free flow of soft or pour material. Plans and descriptions of the arrangement to be used to be submitted for acceptance and no work to proceed until such approval is obtained. Any method which employs simultaneous boring and jacking or drilling and jacking which does not have the above approved arrangement will not be permitted.
1. The use of water or other liquids to facilitate casing emplacement and spoil removal is prohibited.
  2. If an obstruction is encountered during installation to stop the forward action of the pipe, and it becomes evident that it is impossible to advance the pipe, operations to cease and the pipe to be abandoned in place and filled completely with concrete fill.

- D. Bored installations to have a bored hole essentially the same as the outside diameter of the pipe. If voids should develop or if the bored hole diameter is greater than the outside diameter of the pipe by more than approximately one inch, grouting or other acceptable methods to be employed to fill such voids.
- E. When water is known or expected to be encountered, pumps of sufficient capacity to handle the flow to be maintained at the site. When dewatering, close observation to be maintained to detect any settlement or displacement embankment, pavement, and facilities.

#### 3.4 DISPOSAL OF EXCESS AND WASTE MATERIALS

- A. Remove and dispose excess material soil, trash, debris, and other materials not required for use on the project.

END OF SECTION

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SECTION 02505

GRAVEL PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Provide the following Gravel Pavement.
  - a. Geotextile fabric reinforcing.
  - b. Gravel surface course.

B. Related Work in Other Sections:

1. Earthwork including establishment and compaction of subgrades.
2. Submittal requirements.

1.2 SUBMITTALS

A. Product Data: For filter fabric include tensile strength.

B. Material Certificates: Certificates for material shall be signed by the Producer and the Paving Contractor certifying that each material and mixture complies with, or exceed, specified requirements.

1.3 QUALITY ASSURANCE

A. Specified Standards:

1. Comply with applicable provisions referenced herein for the following standards:
  - a. "State of Ohio", Department of Transportation, Construction and Material Specifications" (ODOT).
2. Pavement sections to conform to specified item and additional provisions referenced therein, except:
  - a. Provisions for methods of measurement and payment are inapplicable.
  - b. References to the "Engineer" are to be construed as the Construction Manager.

B. References to "Laboratory" therein or elsewhere in this section are to be construed as the laboratory specified hereinafter under "Testing".

- C. Tests and Inspections: The Owner reserves the right to employ a Testing Laboratory to conduct testing and inspection of materials, and in-place construction.

#### 1.4 JOB CONDITIONS

- A. Grade Control: Establish and maintain required lines and grades, including crown and cross-slopes during construction so that the finished work is within the tolerances required by the Specified Standard.

### PART 2 - PRODUCTS

#### 2.1 GRAVEL PAVEMENT

- A. ODOT Item 411.

#### 2.2 GRAVEL

- A. Provide gravel pavement of sound crushed limestone, crushed gravel or other acceptable material.

#### 2.3 FILTER FABRIC

- A. ODOT Item 712.09.

### PART 3 - EXECUTION

#### 3.1 INSPECTION AND PREPARATION

- A. Examine areas and conditions where paving is to be placed. Notify contractor of conditions detrimental to proper and timely completion of Work. Starting of work constitutes acceptance of subgrade by the installer. Do not install any base course until subgrade has been approved by Construction Manager.
- B. Prior to construction of various components of pavement, e.g., subgrade, filter fabric and surface course, establish and maintain satisfactory lines, levels, layout and stakes. Set stakes not farther than 25 feet on center. Mark stakes to show top elevation of such components including top of paving elevation

#### 3.2 FILTER FABRIC

- A. On finish subgrade constructed loosely lay (do not stretch) a single layer of filter cloth lapped not less than 18 inches at joints and secured with pins as recommended by manufacturer. Use no more than 2 horizontal (in direction of water flow) laps and stagger vertical laps not less than 5 feet.
- B. Use full rolls insofar as practical to minimize vertical laps.

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**3.3 GRAVEL PAVEMENT**

- A. Install pavement courses to the compacted thicknesses required in accordance with the requirements of the Specified Standard for the construction specified under PART 2.
- B. Prior to installation of surface courses, repair any damage caused to subgrade base construction by the work under this specification.

**END OF SECTION**

SECTION 02510

ASPHALTIC CONCRETE PAVEMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Provide the following Flexible Asphalt Pavement.
  - a. Aggregate Base Course.
  - b. Asphaltic Prime Coat.
  - c. Asphaltic Intermediate Course.
  - d. Asphaltic Tack Coat.
  - e. Asphaltic Surface Course.
2. Provide tack coat on existing paving.
3. Prepare subgrade by compacting to specified density.

B. Related Work in Other Sections:

1. Earthwork including establishment and compaction of subgrades.

1.2 SUBMITTALS

- A. Material Certificates: Provide certificates for each type of material and mix signed by the Producer and the Paving Contractor certifying that each material and mixture complies with, or exceed, specified requirements.

1.3 QUALITY ASSURANCE

A. Specified Standards:

1. Comply with State of Ohio, Department of Transportation "Construction and Material Specifications" (ODOT) 1991 Edition.
2. Pavement sections to conform to specified item and additional provisions referenced therein, except:
  - a. Provisions for methods of measurement and payment are inapplicable.
  - b. References to "Engineer" are to be construed as the Construction Manager.

c. References to "Laboratory" therein or elsewhere in this section are to be construed as the laboratory specified hereinafter under "Testing".

B. Tests and Inspections: The Construction Manager will employ a Testing Laboratory to conduct testing and inspection of materials, mixtures, and in-place construction.

### 1.5 JOB CONDITIONS

A. Weather Limitations: Construct work when substrates are dry and ambient temperatures exceed the minimum required by the Specified Standards.

B. Grade Control: Establish and maintain required lines and grades, including crown and cross-slopes, for each course during construction so that the finished work is within the tolerances required by the Specified Standard.

### 1.6 SEQUENCING/SCHEDULING

A. The Subcontractor may, as an option, use pavement bases and/or pavements provided under this section for other operations under these specifications, subject to the following:

1. Immediately prior to application of tack coat for bituminous concrete surface course, return such bases to conditions, lines and grades as shown and specified.
2. Maintain existing and new pavements used during construction in satisfactory condition throughout life of contract. Repair as necessary to restore to specified condition prior to acceptance at completion of job.

B. Coordinate work under this section with work being performed under other sections. Do not construct subgrades or aggregate base until all items shown crossing there under are installed, complete.

## PART 2 - PRODUCTS

### 2.1 MATERIALS AND CONSTRUCTION

A. Pavement to conform to the following:

	<u>Type</u>	<u>Construction (ODOT)</u>
1.	Aggregate Base Course	Item 304
2.	Asphaltic Courses	Item 403, Intermediate Course Item 404, Surface Course
3.	Tack Coat	Item 407
4.	Prime Coat	Item 408

**PART 3 - EXECUTION**

**3.1 INSPECTION**

- A. Examine areas and conditions where paving is to be placed. Notify Construction Manager of conditions detrimental to proper and timely completion of Work.
- B. Starting of work constitutes acceptance.

**3.2 PREPARATION**

- A. Do not install any base course until subgrade has been approved by Testing Laboratory.
- B. Lines and Grades: Prior to construction of various components of pavements, e.g., subgrade, base and paving, establish and maintain satisfactory lines, levels, layout and stakes. Be responsible for same. Employ registered engineer or surveyor for this purpose. Set stakes not farther than 25 feet on center. Mark stakes to show top elevation of such components including top of paving elevation.
- C. Thoroughly clean substrate before application of prime coat.

**3.3 SUBGRADE PREPARATION**

- A. Compact upper 6 inches of subgrade soil to minimum of 95 percent of maximum dry density determined by ASTM Test Method D-698 at a moisture content at least 2 percent over optimum. Overexcavate soft or wet areas to firm soil. If exposed soil is dry and cracked, excavate dry soil to depth of cracks to expose firm and moist soil.

**3.4 PAVEMENT**

- A. Install pavement courses in accordance with requirements of Specified Standard of types and in compacted thicknesses required.
- B. Prior to installation of surface courses, repair any damage caused to pavement base construction by the Contract Work.
- C. Tack Coats:
  - 1. Apply tack coat to existing asphalt and intermediate course.
- D. Make joints between successive day's work for continuous bond and to have same texture, density and smoothness as adjacent surfaces.
- E. Protect newly placed material from traffic until mixture has cooled and attained its maximum degree of hardness.

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Remove and replace mixtures that become contaminated with foreign materials and defective areas and fill with fresh hot mix properly compacted. Remove deficient areas for full depth of course. Cut sides perpendicular and parallel to direction of traffic with edges vertical.

END OF SECTION

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SECTION 02721

CULVERTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Corrugated Metal and Reinforced Concrete pipe.
2. Precast reinforced concrete box sections.
3. Excavation and Backfill.
4. Headwalls.
  - a. Riprap Protection.
  - b. Cast-In-Place Concrete.

B. Related Work in Other Sections:

1. Force Main and Outfall Line.
2. Submittal Requirements.

1.2 QUALITY ASSURANCE

A. Specified Standards:

1. American Concrete Pipe Association: Concrete Pipe Handbook referred to as ACPA Handbook.
2. American Iron and Steel Institute: Handbook of Steel Drainage and Highway Construction Products referred to as AISI Handbook.
3. American Concrete Institute: ACI 301 - Specifications for Structural Concrete for Buildings.

B. Density: Density specified herein refer to the percentage of maximum density of that soil as determined by tests thereon performed in a laboratory in accordance with ASTM D 698.

C. The Construction Manager will provide laboratory inspections required.

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PART 2 - PRODUCTS

2.1 SOIL MATERIAL

- A. Suitable material for support of bedding material will be determined by the Construction Manager.
- B. Bank Run Gravel: Natural Gravel, 100 percent passing 2" sieve, 70 percent retained on a No.8 sieve and not more than 5 percent passing a No.200 sieve.
- C. Coarse Aggregate: ASTM C 33, Size No.7 or No.8.

2.2 PIPE

- A. Corrugated Metal Pipe: AASHTO M-190, Type B, bituminous coated and half paved, sizes and gages, as shown, or lightest commercially available standard gage listed for pipe size, where not shown. Furnish with appropriate watertight bituminous coated coupling bands.
- B. Reinforced Concrete Pipe: ASTM C 76, sizes and class as shown, or Class IV where class is not shown. Provide with joints conforming to ASTM C 443.
- C. Precast Reinforced Concrete Box Sections:
  - 1. For Sections with 2'-0" or more of cover: ASTM C 789.
  - 2. For Sections with less than 2'-0" of cover: ASTM C 850.

2.3 CAST IN PLACE CONCRETE

- A. Concrete materials and proportioning:
  - 1. Minimum compressive strength: 4,000 psi.
  - 2. Entrained Air: 4% to 8%.
- B. Reinforcement: ASTM A 615 or A 616, Grade 60.
- C. Formwork: Suitable for smooth form finish on exposed surfaces.
- D. Calking: One component polyurethane ASTM C 920 Type S, Gr. NS class 25.

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## 2.4 RIPRAP

- A. Quarry stone, well graded in size and having a percentage of wear no higher than 60 as determined by ASTM C 535 or AASHTO T-96. Provide in pieces essentially cubical in shape, with no dimension of any piece greater than 3 times any other dimension of that piece. Provide in following gradations:
1. Type A:
    - a. Maximum size (pounds per piece): 150.
    - b. Minimum size (pounds per piece): 10.
    - c. 75 percent in pieces weighing more than (pounds per piece): 50.
  2. Type B:
    - a. Maximum size (pounds per piece): 75.
    - b. Minimum size (pounds per piece): 5.
    - c. 75 percent in pieces weighing more than (pounds per piece): 25.
- B. Same material as riprap with 100 percent passing the 3 inch screen and 95 percent retained on 1/4 inch screen.

## 2.5 FILTER FABRIC

- A. Polypropylene plastic fabric, Dupont Typar, Celanese Mirafil 140 or Poly-Filter GB as manufactured by Carthage Mills.

## PART 3 - EXECUTION

### 3.1 EXCAVATION AND BACKFILL

- A. Keep excavations dry prior to placing culvert. Remove all excess earth.
- B. For placing pipe in fill, place fill no lower than 12 inches above bottom of pipe prior to excavating.
- C. During pipe placing, round pipe bed and excavate at joints if necessary so that pipe is uniformly supported for its entire length.
- D. Backfill with backrun gravel.

### 3.2 CULVERT LAYING

- A. Lay culvert to uniform grade or slight pitch so that culvert drains to outlet. Use transit and levels to insure slope to drain. Set each length to line and grade before making joints.

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- B. Close open ends of culvert to prevent earth from entering during construction.

### 3.2 HEADWALLS

- A. Construction workmanship to conform to applicable provisions of ACI 301.
- B. Provide smooth formed finish on exposed concrete surfaces. Chamfer exposed corners 3/4 inch.
- C. Provide calk space between each face of headwall and pipe.

### 3.3 RIPRAP

- A. Preparation of subgrade: On finish subgrade loosely lay (do not stretch) a single layer of filter cloth lapped not less than 18 inches at joints and secured with pins as recommended by manufacturer. Use no more than 2 horizontal (in direction of water flow) laps and stagger vertical laps not less than 5 feet. Use full rolls insofar as practical to minimize vertical laps.
- B. Placing:
  - 1. Dump riprap on fabric from height not greater than 5 feet in manner to avoid injury to filter fabric, to avoid segregation, and to obtain maximum density. Rearrange by hand or raking as necessary to obtain a flat and dense surface.
  - 2. Cover riprap with dumped crushed rock and spalls and rake into riprap to insure that all chinks between larger rocks are well filled and that surface presents a smooth and pleasing appearance.

END OF SECTION

SECTION 02831

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CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Galvanized steel chain link fence.
2. Barbed Wire top.
3. Removal of existing fencing.
4. Relocation of existing fence wire fabric and barbed wire.

B. Related Work in Other Sections:

1. Earthwork for filling and grading work.

1.2 DESCRIPTIONS

A. Fence: Provide 8 foot high fence constructed as follows:

1. Barbed Wire:
  - a. Single 45-degree arm for three strands barbed wire, one for each post.
2. Bracing:
  - a. Top Rail and bottom tension wire.

1.3 SUBMITTALS

- A. Product data in the form of manufacturer's technical data, specifications, and installation instructions for fence and gate posts, fabric, gates, and accessories.
- B. Shop drawings showing location of fence, each post, and details of post installation, extension arms, and accessories.

1.4 QUALITY ASSURANCE

- A. Single-Source Responsibility: Obtain chain link fence as complete unit, including necessary erection accessories, fittings, and fastenings from a single source or manufacturer.

**PART 2 PRODUCTS**

**2.1 FABRIC**

- A. Selvage: Fabric 72 inches high and over with 2- or 2-1/8-inch mesh shall be knuckled at one selvage and twisted at the other; all mesh 60 inches high and under shall be knuckled at both selvages.
  
- B. Steel Fabric: Comply with Chain Link Fence Manufacturers Institute (CLFMI) Product Manual. Furnish one-piece fabric widths for fencing up to 12 feet high. Wire size includes zinc coating.
  - 1. Size:
    - a. 2-inch mesh, 9-gage (0.148-inch diameter) wire.
  
  - 2. Finish:
    - a. Galvanized Steel: ASTM A 392, Class 2, with not less than 2.0 oz. zinc per sq. ft. of uncoated wire surface on wire coated before weaving or not less than 2.0 oz. zinc per sq. ft. of uncoated wire surface on wire of fabric coated after weaving as determined from the average of two or more samples and not less than 1.8 oz. zinc per sq. ft. of uncoated wire surface for any individual sample.

**2.3 FRAMING**

- A. Strength requirements for posts and rails conforming to ASTM F 669.
  
- B. Pipe shall be straight, true to section, material, and sizes specified, and shall conform to the following weights per foot:

<u>NPS in inches</u>	<u>Outside Diameter (OD) in inches</u>	<u>Type I Steel</u>
1-1/4	1.660	2.27
2	2.375	3.65
2-1/2	2.875	5.79

- C. Steel Framework: Posts, rails, braces, and gate frames.
  - 1. Type I Pipe: Hot-dipped galvanized steel pipe conforming to ASTM F 1083, plain ends, standard weight (schedule 40) with not less than 1.8 oz. zinc per sq. ft. of surface area coated.
  
- D. End, corner, and pull posts for following fabric heights:
  - 1. Over 6 feet: 2.875-inch OD Type I steel pipe.

E. Line or intermediate posts for following fabric heights:

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1. 2.375-inch OD Type I steel pipe.

F. Top Rail: Manufacturer's longest lengths, with expansion-type couplings, approximately 6 inches long, for each joint. Provide means for attaching top rail securely to each gate corner, pull, and end post.

1. Galvanized Steel: 1-1/4-inch NPS (1.66-inch OD) Type I steel pipe.

#### 2.4 BARBED LINES

A. Barbed Wire Supporting Arms: Manufacturer's standard barbed wire supporting arms conforming to ASTM F 626, metal and finish to match fence framework, with provision for anchorage to posts and attaching three rows of barbed wire to each arm. Supporting arms may be either attached to posts or integral with post top weather cap and must be capable of withstanding 250 lb. downward pull at outermost end.

B. Steel Barbed Wire: Two strand, 12-1/2-gage steel wire with 14-gage, 4-point barbs spaced not more than 5 inches o.c.; metallic coated finish to match fabric.

1. Galvanized Steel Barbed Wire: Comply with ASTM A 121.

#### 2.5 FITTINGS AND ACCESSORIES

A. Material: Comply with ASTM F 626. Galvanized steel, to suit manufacturer's standards.

1. Zinc Coating: Unless specified otherwise, galvanize steel fence fittings and accessories in accordance with ASTM A 153, with zinc weights per Table I.

B. Tension Wire: 0.177-inch-diameter metallic-coated steel marcelled tension wire conforming to ASTM A 824 with finish to match fabric.

1. Type II Zinc Coated in following class:

a. Class 2, with a minimum coating weight of 1.20 oz. per sq. ft. of uncoated wire surface.

C. Tie Wires: 12-gage (0.106-inch diameter) galvanized steel with a minimum of 0.80 oz. per sq. ft. of zinc coating of surface area in accordance with ASTM A 641, Class 3 or 9-gage (0.106-inch-diameter) aluminum wire alloy 1100-H14 or equal, to match fabric core material.

D. Post Brace Assembly: Manufacturer's standard adjustable brace at end posts and at both sides of corner and pull posts, with horizontal brace located at midheight of fabric. Use same material as top rail for brace, and truss to line posts with 3/8-inch-diameter rod and adjustable tightener. Provide manufacturer's standard galvanized steel cap for each end.

E. Tension or Stretcher Bars: Hot-dip galvanized steel with minimum length 2 inches less than full height of fabric, minimum cross-section of 3/16 inch by 3/4 inch and minimum 1.2 oz. zinc

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coating per sq. ft. of surface area. Provide one bar for each end post, and two for each corner and pull post, except where fabric is integrally woven into post.

- F. **Concrete:** Provide concrete consisting of Portland cement, ASTM C 150, aggregates ASTM C 33, and clean water. Mix materials to obtain concrete with a minimum 28-day compressive strength of 2500 psi. Use at least 4 sacks of cement per cu. yd., 1-inch maximum size aggregate, maximum 3-inch slump, and 2 to 4 percent entrained air.

### PART 3 - EXECUTION

#### 3.1 REMOVAL OF EXISTING FENCES

- A. **Reused Fencing:** Prior to starting new fence work, carefully remove existing fence fabric, caps and accessories that are to be relocated from the area. Store reused material off ground in secure areas and in a manner to avoid deterioration and damage.
- B. **Remove posts and footings in their entirety and dispose.**
1. Reuse of existing posts is prohibited.
- C. **Remove all disposed material from the site immediately.**

#### 3.2 INSTALLATION

- A. **General:** Install fence in compliance with ASTM F 567. Do not begin installation and erection before final grading is completed, unless otherwise permitted.
- B. **Excavation:** Drill or hand-excavate (using post-hole digger) holes for posts to diameters and spacings indicated, in firm, undisturbed or compacted soil.
- C. **Setting Posts:** Center and align posts in holes 4 inches above bottom of excavation. Space maximum 10 feet o.c., unless otherwise indicated.
1. Protect portion of posts above ground from concrete splatter. Place concrete around posts and vibrate or tamp for consolidation. Check each post for vertical and top alignment, and hold in position during placement and finishing operations.
  2. Unless otherwise indicated, extend concrete footings 2 inches above grade and trowel to a crown to shed water.
- D. **Top Rails:** Run rail continuously through line post caps, terminating into rail end attached to posts or post caps fabricated to receive rail. Provide expansion couplings as recommended by fencing manufacturer.
- E. **Brace Assemblies:** Install braces so posts are plumb when diagonal rod is under proper tension.
- F. **Bottom Tension Wire:** Install tension wire within 2 inches of bottom of fabric before stretching fabric and tie to each post with not less than same gage and type of wire. Pull wire taut,

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without sags. Fasten fabric to tension wire with 11-gage hog rings of same material and finish as fabric wire, spaced maximum 24 inches o.c.

- G. Fabric: Leave approximately 2 inches between finish grade and bottom selvage unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Install fabric on security side of fence, and anchor to framework so that fabric remains in tension after pulling force is released.
- H. Tension or Stretcher Bars: Thread through or clamp to fabric 4 inches o.c., and secure to end, corner, pull, and gate posts with tension bands spaced not over 15 inches o.c.
- I. Tie Wires: Use U-shaped wire of proper length to secure fabric firmly to posts and rails with ends twisted at least 2 full turns. Bend ends of wire to minimize hazard to persons or clothing.
  - 1. Maximum Spacing: Tie fabric to line posts 12 inches o.c. and to rails and braces 24 inches o.c.
- J. Fasteners: Install nuts for tension bands and hardware bolts on side of fence opposite fabric side. Peen ends of bolts or score threads to prevent removal of nuts.
- K. Barbed Wire: Pull wire taut and install securely to extension arms and secure to end post or terminal arms in accordance with manufacturer's instructions.

END OF SECTION

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SECTION 02930

TOPSOIL AND GRASS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fine grading and preparation of grass areas.
2. Spreading topsoil from stockpiles.
3. Furnishing and application of fertilizer.
4. Seeding of new grass areas.
5. Maintenance of grass areas.
6. Replanting of unsatisfactory or damaged grass.

B. Related Work in Other Sections:

1. Grading and excavation.
2. Submittal Requirements.

1.2 DESCRIPTIONS

- A. Topsoil and grass all areas disturbed by construction and not covered by other construction.
- B. Recondition existing grassed areas damaged by Contractor's operations including storage of materials or equipment and movement of vehicles. Also recondition grass areas where settlement or washouts occur or where minor regrading is required.
- C. Provide erosion control in the following areas:
  1. All areas to be seeded.
  2. In drainage channels.

1.3 SUBMITTALS

- A. Product Certification: Submit inspection certificates required by governing authorities to accompany shipments. For standard products submit manufacturer's certified analysis.
- B. Certification of Grass Seed: Submit seed vendor's certified statement for seed mixture, stating botanical and common name; percentage by weight; and percentages of purity, germination, and weed seed for grass seed.

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1.4 QUALITY ASSURANCE

- A. Comply with applicable federal, state, county, and local regulations governing landscape materials and work.
- B. Employ only experienced personnel familiar with required work. Provide adequate supervision by qualified foreman.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. **Packaged Materials:** Deliver packaged materials in containers showing weight, analysis, and manufacturer's name. Protect materials from deterioration during delivery and while stored at site.

1.6 PROJECT CONDITIONS

- A. Proceed with and complete grassing as rapidly as portions of site become available, working within seasonal limitations.
- B. Coordinate with work of other sections:
  - 1. **Utilities:** Determine location of underground utilities and perform work in a manner to avoid possible damage.
  - 2. Maintain grade stakes set by others until removal is mutually agreed upon by entities involved.
- C. **Excavation:** When conditions detrimental to plant growth, such as rubble fill, adverse drainage conditions, or obstructions, are encountered, notify the Construction Manager before planting.
- D. **Planting Time:**
  - 1. Topsoil and seed during normal planting seasons of the project locale.
  - 2. Do not plant in frozen ground.

1.7 MAINTENANCE

- A. Begin maintenance immediately after each area is planted; continue maintenance until the latest of period: period required to establish acceptable stand of grass.
- B. Maintain grass by watering; fertilizing; mowing; trimming; and other operations such as rolling, regrading, and replanting as required to establish a smooth, acceptable stand of grass.
  - 1. **Basis of acceptance:** At end of maintenance period, grass shall be uniform in texture, density, and color; substantially weed-free; without gaps or bare spots; and with vigorous growth of proper grass.
  - 2. **Mulch:** Replace mulch in areas where mulch has been displaced. Anchor as required to prevent displacement.

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3. Watering: Keep grass areas uniformly moist as required for proper growth.
  - a. Lay out watering system and arrange schedule to prevent puddling, erosion, and displacement of seed.
4. Mow grass at regular intervals to maintain a maximum height of 1-1/2 inches. Do not cut more than 1/3 of grass blade at any one mowing.
5. Control growth of weeds. Apply herbicides in accordance with manufacturer's instructions. Remedy damage resulting from use of herbicides.
6. Provide warning signs, barricades, or both, as required to protect new grass from traffic damage.

## PART 2 - PRODUCTS

### 2.1 TOPSOIL

- A. Topsoil: Fertile agricultural soil, typical for locality, capable of sustaining vigorous plant growth and taken from a drained site; free of subsoil, rocks larger than 2 inches in diameter, clay, toxic matter, plants, weeds, and roots.

### 2.2 SOIL AMENDMENTS

- A. Commercial Fertilizer: Complete fertilizer of neutral character, containing:
  1. Minimum content of available plant nutrients: 12 percent nitrogen, 12 percent phosphoric acid, and 12 percent soluble potash.

### 2.3 GRASS MATERIALS

- A. Grass Seed: Provide fresh, clean, new crop seed complying with tolerance for purity and germination established by the Association of Official Seed Analysts.
- B. Grass Seed Mix:
  1. Provide certified mixture as follows:
    - a. 30 percent by weight rough bluegrass (*Poa trivialis*).
    - b. 60 percent by weight K-31 tall fescue (*Festuca elatior* var.).
    - c. 10 percent by weight perennial ryegrass (*Lolium perenne*).
  2. Sowing rate: 3 pounds per 1000 square feet.

### 2.4 MISCELLANEOUS LANDSCAPE MATERIALS

- A. Mulch: Clean, seed-free hay or threshed straw of wheat, rye, oats, or barley.

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- B. Asphalt Emulsion: ASTM D 977.

## 2.5 PLANTING SOIL

- A. Mixing: Mix topsoil and fertilizer thoroughly to provide uniform mixture, using powered rotary tiller, or other means acceptable to the Owner's Representative.

1. Commercial fertilizer: 2 pounds per 100 square feet of surface area.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Preparation of Planting Soil:

1. Before mixing, clean topsoil of roots, plants, sods, stones, clay lumps, and other extraneous materials harmful to plant growth.
2. Mix fertilizer with topsoil at rates specified.
  - a. Delay mixing of fertilizer if planting will not follow placing of planting soil within a few days.
3. Apply soil fertilizer on surface of topsoil and mix before planting.

- B. Preparation for Planting:

1. Limit preparation to areas which will be planted promptly after preparation.
2. Preparation of stripped areas: Loosen subgrade to a minimum depth of 4 inches.
  - a. Remove stones of more than 1-1/2 inches in any dimension, sticks, roots, rubbish and other extraneous matter.
  - b. Spread topsoil to minimum depth required to meet lines, grades, and elevations shown, allowing for light rolling and natural settlement.
3. Fine-grade area to smooth, even surface with loose, fine texture. Roll, rake, and drag grass areas, removing ridges and filling depressions, as required to meet finish grades.
4. Moisten prepared areas before planting if soil is dry. Water thoroughly and allow surface moisture to dry before planting grass. Do not create a muddy soil condition.
5. Prior to planting, restore to specified condition areas eroded or otherwise disturbed after fine grading.

### 3.2 SEEDING GRADED AREAS

- A. **Seeding:** Sow seed using a spreader or seeding machine. Do not seed when wind velocity exceeds 5 miles per hour. Distribute seed evenly over entire area by sowing equal quantities in 2 directions at right angles to each other.
1. Do not use seed which is moldy, wet, or otherwise damaged in transit or storage.
  2. Sow not less than the quantity of seed specified.
  3. Rake seed lightly into top 1/8 inch of topsoil, roll lightly, and water with fine spray.
- B. **Hydroseeding:** Use only equipment specifically designed for hydraulic seeding application.
1. Mix seed, fertilizer, and pulverized mulch in water. Mix until uniformly blended into homogeneous slurry; continue mixing during application.
  2. Apply slurry uniformly to all areas to be seeded. Rate of application as required to obtain specified sowing rate.

### 3.3 RESTORING EXISTING GRASS

- A. **Removals:** Strip diseased, contaminated, or otherwise unsatisfactory grass areas and dispose of vegetation off site; do not bury into topsoil.
1. Remove topsoil containing foreign materials resulting from contractor's operations, including, but not limited to, oil drippings, stone, gravel, and other construction material; replace with new topsoil.
  2. Plant grass as specified for new grass in similar areas.
- B. **Reseeding:** Where substantial grass remains (but is thin), mow, rake, aerate if compacted, fill low spots, remove humps, remove thatch, remove lumps and cultivate soil, fertilize, and seed.
1. If weeds are extensive, apply selective chemical weed killers as required.
- C. Apply seed mulch if required to keep soil moist.
- D. Water newly planted areas and keep moist until new grass is established.

3.4 INSTALLATION OF MISCELLANEOUS MATERIALS

A. Erosion Control:

1. Straw mulch: Spread uniform layer 1-1/2 inches thick. Apply asphalt emulsion coating to straw at the rate of 10 to 13 gallons per 1000 square feet. Take precautions to prevent damage or staining of structures or other plantings adjacent to mulched areas. Immediately clean such areas where damage occurs.

END OF SECTION

SECTION 03310

CAST-IN PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Cast-in-place concrete formwork, reinforcing, concrete, finishing and curing for:
  - a. Foundations; pit walls.
  - b. Slabs on grade; pit slabs.
2. Provide vapor barrier over prepared base material, and covered with sand, below slabs on grade.
3. Placing anchor Bolts, and miscellaneous metal embedded in Concrete.
4. Perimeter Insulation.

B. Related Work in Other Sections:

1. Subgrade preparation and bases below vapor barrier and slabs on grade.
2. Precast concrete; splash blocks.
3. Cast-in embedded miscellaneous metals.
4. Waterproofing.

1.2 SUBMITTALS

A. Product Data: Submit data for the following proprietary materials:

1. Curing compounds.
2. Admixtures.
3. Waterstops.
5. Liquid hardeners and sealers.

B. Shop Drawings:

1. Reinforcement: Submit shop drawings prepared by registered Professional Engineer showing bar schedules, stirrup spacing, diagrams of bent bars, arrangement, bending, and placement of reinforcement.
  - a. Comply with ACI SP-66 "ACI Detailing Manual".

C. Laboratory Test Reports: Submit laboratory test reports for concrete materials and mix design test.

1.3 QUALITY ASSURANCE

A. Codes and Standards: Comply with provisions of following codes, specifications, and standards, except where more stringent requirements are shown or specified:

1. ACI 301 "Specifications for Structural Concrete for Buildings".
2. ACI 304 "Guide for Measuring, Mixing, Transporting and Placing Concrete".
3. ACI 305 "Hot Weather Concreting".
4. ACI 306 "Cold Weather Concreting".
5. ACI 318 "Building Code Requirements for Reinforced Concrete".
6. Concrete Reinforcing Steel Institute (CRSI), "Manual of Standard Practice".

B. Concrete Testing Service: Construction Manager will arrange and pay for the services of an independent testing laboratory to perform material evaluation tests.

C. Retesting of rejected materials, shall be at the Contractor's expense.

1.4 PROJECT CONDITIONS

A. Protection of Footings Against Freezing: Cover completed work at footing level with sufficient temporary or permanent cover as required to protect footings and adjacent subgrade against possibility of freezing; maintain cover for time period as necessary.

B. Protect adjacent finish materials against spatter during concrete placement.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

A. Codes and Standards:

ACI 347 Guide to Formwork for Concrete

ACI SP-4 Formwork for Concrete

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- B. Forms for Exposed Finish Concrete: Plywood, metal, metal-framed plywood faced, or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on drawings.
- B. Forms for Unexposed Finish Concrete: Plywood, lumber, metal, or other acceptable material. Provide lumber dressed on at least 2 edges and one side for tight fit.
- C. Form Coatings: Commercial formulation form-coating compounds that will not bond with, stain, nor adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces.
- D. Form Ties: Factory-fabricated, adjustable-length, removable or snapoff metal form ties, designed to prevent form deflection and to prevent spalling concrete upon removal. Provide units which will leave no metal closer than 1-1/2" to surface.

## 2.2 REINFORCING MATERIALS

- A. Reinforcing Bars: ASTM A 615 or A 616, Grade 60, deformed.
- B. Supports for Reinforcement: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Use wire bar type supports complying with CRSI specifications.
  - 1. For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs.

## 2.3 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type I or the following when authorized by the Construction Manager.
  - 1. Type III - High Early Strength.
  - 2. Type IA - Air Entraining Cement.
  - 3. Type IIIA - High Early Strength, Air Entraining.
- B. Use one brand of cement throughout project, unless otherwise acceptable to The Construction Manager.
- C. Normal Weight Aggregates: ASTM C 33, and as herein specified. Provide aggregates from a single source for exposed concrete.
  - 1. For exterior exposed surfaces, do not use fine or coarse aggregates containing spalling-causing deleterious substances.
  - 2. Local aggregates not complying with ASTM C 33 but which have shown by special test or actual service to produce concrete of adequate strength and durability may be used when acceptable to Construction Manager.

- D. Water: Drinkable.
- E. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.
- F. Prohibited Admixtures: Calcium chloride thycyanates or admixtures containing more than 0.1 percent chloride ions are not permitted.

#### 2.4 RELATED MATERIALS

- A. Waterstops: Provide flat, dumbbell type or centerbulb type waterstops at construction joints and other joints as indicated. Size to suit joints.
  - 1. Polyvinyl Chloride Waterstops: Corps of Engineers CRD-C 572.
- B. Vapor Barrier: Use only materials which are resistant to decay when tested in accordance with ASTM E 154, as follows:
  - 1. Polyethylene sheet not less than 8 mils thick.
  - 2. Water resistant barrier paper consisting of heavy Kraft papers laminated together with glass fiber reinforcement and over- coated with black polyethylene on each side.
  - 3. Tape: Pressure sensitive reinforced sheeting recommended by vapor barrier manufacturer.
- C. Granular Base: Evenly graded mixture of fine and coarse aggregates to provide, when compacted, a smooth and even surface below slabs on grade.
- D. Chemical Hardener: Colorless aqueous solution containing a blend of magnesium fluosilicate and zinc fluosilicate combined with a wetting agent, containing not less than 2 lbs. of fluosilicates per gal.
- E. Moisture-Retaining Cover: One of the following, complying with ASTM C 171.
  - 1. Waterproof paper.
  - 2. Polyethylene film.
- F. Perimeter Insulation
  - 1. Provide extruded polystyrene board insulation. Acceptable products:
    - a. "Amofoam" Amoco Foam Products Co.
    - b. "Styrofoam" Dow Chemical Company.
    - c. "FOAMULAR" U. C. Industries, Inc.

H. Epoxy Adhesive: ASTM C 881, two component material suitable for use on dry or damp surfaces. Provide material "Type", "Grade", and "Class" to suit project requirements.

1. Acceptable Products:

- a. "Thiopoxy"; W.R. Grace.
- b. "Epoxite"; A.C. Horn, Inc.
- c. "Sikadur Hi-Mod"; Sika Chemical Corp.
- d. "Euco Epoxy 452 or 620"; Euclid Chemical Co.

2.5 PROPORTIONING AND DESIGN OF MIXES

A. Provide standard FMPC concrete mix design.

- 1. Interior slab-on-grade: FMPC No. 3
- 2. All other concrete: FMPC No. 4

2.6 CONCRETE MIXING

A. Provide batch ticket for each batch discharged and used in work, indicating project identification name and number, date, mix type, mix time, quantity, and amount of water introduced.

PART 3 - EXECUTION

3.1 GENERAL

- A. Coordinate the installation of joint materials and vapor barrier with placement of forms and reinforcing steel.
- B. Earth cuts may be used as forms for footings if concrete is not exposed in finish surface and sides can be kept reasonably vertical.

3.2 FORMS

- A. Design, erect, support, brace, and maintain formwork to support vertical and lateral, static, and dynamic loads that might be applied until such loads can be supported by concrete structure. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation, and position. Maintain formwork construction tolerances complying with ACI 347.
- B. Design formwork to be readily removable without impact, shock, or damage to cast-in-place concrete surfaces and adjacent materials.
- C. Construct forms to sizes, shapes, lines, and dimensions shown, and to obtain accurate alignment, location, grades, level and plumb work in finished structures. Provide for openings, offsets, chamfers, inserts, and other features required in work. Use selected materials to obtain

required finishes. Solidly butt joints and provide back-up at joints to prevent leakage of cement paste.

- D. Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete. Securely brace temporary openings and set tightly to forms to prevent loss of concrete mortar. Locate temporary openings on forms at inconspicuous locations.
- E. Chamfer exposed corners and edges as indicated, using wood, metal, PVC, or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.
- F. Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, from trades providing such items. Accurately place and securely support items built into forms.
- G. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, or other debris just before concrete is placed. Retighten forms and bracing after concrete placement as required to eliminate mortar leaks and maintain proper alignment.

### 3.3 PLACING REINFORCEMENT

- A. Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars", for details and methods of reinforcement placement and supports, and as herein specified.
  - 1. Do not cut or puncture barrier retarder during reinforcement placement and concreting operations.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials which reduce or destroy bond with concrete.
- C. Accurately position, support, and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as required.
- D. Place reinforcement to obtain at least minimum coverages as required by ACI 301 for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

### 3.4 JOINTS

- A. Construction Joints: Locate and install construction joints so as not to impair strength and appearance of the structure, as acceptable to Construction Manager.
- B. Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints, except as otherwise indicated.

- C. Waterstops: Provide waterstops in construction joints as indicated. Install waterstops to form continuous diaphragm in each joint. Make provisions to support and protect exposed waterstops during progress of work. Fabricate field joints in waterstops in accordance with manufacturer's printed instructions.

### 3.5 INSTALLATION OF EMBEDDED ITEMS

- A. Set and build into work embedded items required for other work that is attached to, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions, and directions provided by suppliers of items to be attached thereto.
- B. Set anchor bolts for steel and equipment in accordance with the setting drawings or templates which have been reviewed and found satisfactory.

### 3.6 PREPARATION OF FORM SURFACES

- A. Clean re-used forms of concrete matrix residue, repair and patch as required to return forms to acceptable surface condition.
- B. Coat contact surfaces of forms with a form-coating compound approved by the Construction Manager before reinforcement is placed.
- C. Thin form-coating compounds only with thinning agent of type, amount, and under conditions of form-coating compound manufacturer's directions. Do not allow excess form-coating material to accumulate in forms or to come into contact with in-place concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions.
- D. Coat steel forms with a non-staining, rust-preventative form oil or otherwise protect against rusting. Rust-stained steel formwork is not acceptable.

### 3.7 CONCRETE PLACEMENT

- A. Preplacement Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast-in. Notify other crafts to permit installation of their work; cooperate with other trades in setting such work. Moisten wood forms immediately before placing concrete where form coatings are not used.
1. Apply temporary protective covering to lower 2' of finished walls adjacent to poured floor slabs and similar conditions, and guard against spattering during placement.
- B. Comply with ACI 304 "Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete", and as herein specified.
- C. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete as nearly as practicable to its final location to avoid segregation.
- D. Placing Concrete in Forms: Deposit concrete in forms in horizontal layers not deeper than 18" and in a manner to avoid inclined construction joints. Where placement consists of several

layers, place each layer while preceding layer is still plastic to avoid cold joints. Do not allow free fall exceeding 5'-0".

- E. Consolidate placed concrete by mechanical vibrating equipment with a minimum frequency of 7,000 cycles per minute supplemented by hand-spading, rodding, or tamping. Use equipment and procedures for consolidation of concrete in accordance with ACI 309.
- F. Do not use vibrators to transport concrete inside forms. Do not allow external vibration of forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine. Place vibrators to rapidly penetrate placed layer and at least 6" into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.
- G. Placing Concrete Slabs: Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed.
- H. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.
- I. Bring slab surfaces to correct level with straightedge and strikeoff. Use bull floats or darbies to smooth surface, free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.
- J. Maintain reinforcing in proper position during concrete placement operations.
- K. Cold Weather Placing: Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 306 and as herein specified.
- L. When air temperature has fallen to or is expected to fall below 40 deg F (4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C), and not more than 80 deg F (27 deg C) at point of placement.
- M. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
- N. Do not use calcium chloride, salt, and other materials containing antifreeze agents or chemical accelerators, unless otherwise accepted in mix designs.
- O. Hot Weather Placing: When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified.
- P. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 deg F (32 deg C). Mixing water may be chilled, or chopped ice may be used to control temperature provided water equivalent of ice is calculated to total amount of mixing water. Use of liquid nitrogen to cool concrete is Contractor's option.

- Q. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.
- R. Fog spray forms, reinforcing steel, and subgrade just before concrete is placed.

### 3.8 FINISH OF FORMED SURFACES

- A. **Rough Form Finish:** For formed concrete surfaces not exposed-to-view in the finish work or by other construction, unless otherwise indicated. This is the concrete surface having texture imparted by form facing material used, with tie holes and defective areas repaired and patched and fins and other projections exceeding 1/4" in height rubbed down or chipped off.
- B. **Smooth Form Finish:** For formed concrete surfaces exposed-to-view, or that are to be covered with a covering material applied directly to concrete, such as waterproofing, or other similar system. This is as-cast concrete surface obtained with selected form facing material, arranged orderly and symmetrically with a minimum of seams. Repair and patch defective areas with fins or other projections completely removed and smoothed.
- C. **Related Unformed Surfaces:** At tops of walls, and similar unformed surfaces occurring adjacent to formed surfaces, strike-off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

### 3.9 MONOLITHIC SLAB FINISHES

- A. **Float Finish:** Apply float finish to monolithic slab surface to receive trowel finish as hereinafter specified.
  - 1. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both. Consolidate surface with power-driven floats, or by hand-floating if area is small or inaccessible to power units. Check and level surface plane to tolerances of FF 18 - FL 15. Cut down high spots and fill low spots. Uniformly slope surfaces as indicated. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.
- B. **Trowel Finish:** Apply trowel finish to monolithic slab surfaces to be exposed-to-view.
  - 1. After floating, begin first trowel finish operation using a power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and with surface leveled to tolerances of FF 20 - FL 17.

- C. **Chemical-Hardener Finish:** Apply chemical-hardener finish to interior concrete floors. Apply liquid chemical-hardener after complete curing and drying of the concrete surface. Dilute liquid hardener with water and apply in 3 coats; first coat, 1/3-strength; second coat, 1/2-strength; third coat, 2/3-strength. Evenly apply each coat, and allow 24 hours for drying between coats.
1. Apply proprietary chemical hardeners, in accordance with manufacturer's printed instructions.
  2. After final coat of chemical-hardener solution is applied and dried, remove surplus hardener by scrubbing and mopping with water.

### 3.10 CONCRETE CURING AND PROTECTION

- A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than 7 days.
- C. Begin final curing procedures immediately following initial curing and before concrete has dried. Continue final curing for at least 7 days in accordance with ACI 301 procedures. Avoid rapid drying at end of final curing period.
- D. **Curing Methods:** Perform curing of concrete by curing and sealing compound, by moist curing, by moisture-retaining cover curing, and by combinations thereof, as herein specified.
- E. Provide moisture curing by following method.
  1. Covering concrete surface with specified absorptive cover, thoroughly saturating cover with water and keeping continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with 4" lap over adjacent absorptive covers.
- F. Provide moisture-cover curing as follows:
  1. Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3" and sealed by waterproof tape of adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
- G. **Curing Unformed Surfaces:** Cure unformed surfaces, such as slabs, and other flat surfaces by application of appropriate curing method.
- H. Final cure concrete surfaces to receive liquid floor hardener by use of moisture-retaining cover, unless otherwise directed.

### 3.11 REMOVAL OF FORMS

- A. Formwork not supporting weight of concrete, such as vertical surfaces, may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete,

provided concrete is sufficiently hard to not be damaged by form removal operations, and provided curing and protection operations are maintained.

### 3.12 RE-USE OF FORMS

- A. Clean and repair surfaces of forms to be re-used in work. Split, frayed, delaminated, or otherwise damaged form facing material will not be acceptable for exposed surfaces. Apply new form coating compound as specified for new formwork.
- B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joint to avoid offsets. Do not use "patched" forms for exposed concrete surfaces, except as acceptable to Construction Manager.

### 3.13 VAPOR BARRIER INSTALLATION

- A. Following leveling and tamping of granular base for slabs-on-grade, place vapor barrier sheeting with longest dimension parallel with direction of pour.
- B. Lap joints 6" and seal with appropriate tape.
- C. After placement of vapor barrier, cover with minimum 2" sand and compact to 95% standard proctor.

### 3.14 PERIMETER INSULATION

- A. Where insulation is shown in vertical position:
  - 1. Place insulation strip on side of exterior foundation walls. Set slabs with staggered joints.
  - 2. Cement slabs to wall and seal joints with special adhesive recommended by manufacturer of insulation.
- B. Take all necessary measures to avoid injury to insulation in placing of fill and concrete.

### 3.15 MISCELLANEOUS ITEMS

- A. Filling-In: Fill-in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place, and cure concrete as herein specified, to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete work.

### 3.16 CONCRETE SURFACE REPAIRS

- A. Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removal of forms, when acceptable to Construction Manager.
  - 1. Cut out honeycomb, rock pockets, voids over 1/4" in any dimension, and holes left by tie rods and bolts, down to solid concrete but, in no case to a depth of less than 1". Make

edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water, and brush-coat the area to be patched with specified bonding agent. Place patching mortar after bonding compound has dried.

2. For exposed-to-view surfaces, blend white portland cement and standard portland cement so that, when dry, patching mortar will match color surrounding. Provide test areas at inconspicuous location to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.
- B. Repair of Formed Surfaces: Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Construction Manager. Surface defects, as such, include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets; fins and other projections on surface; and stains and other discolorations that cannot be removed by cleaning. Flush out form tie holes, fill with dry pack mortar, or precast cement cone plugs secured in place with bonding agent.
1. Repair concealed formed surfaces, where possible, that contain defects that affect the durability of concrete. If defects cannot be repaired, remove and replace concrete.
- C. Repair of Unformed Surfaces: Test unformed surfaces, such as monolithic slabs, for smoothness and verify surface plane to tolerances specified for each surface and finish. Correct low and high areas as herein specified. Test unformed surfaces sloped to drain for trueness of slope, in addition to smoothness using a template having required slope.
1. Repair finished unformed surfaces that contain defects which affect durability of concrete. Surface defects, as such, include crazing, cracks in excess of 0.01" wide or which penetrate to reinforcement or completely through non-reinforced sections regardless of width, spalling, pop-outs, honeycomb, rock pockets, and other objectionable conditions.
  2. Correct high areas in unformed surfaces by grinding, after concrete has cured at least 14 days.
  3. Correct low areas in unformed surfaces during or immediately after completion of surface finishing operations by cutting out low areas and replacing with fresh concrete. Finish repaired areas to blend into adjacent concrete. Proprietary patching compounds may be used when acceptable to Owner's Representative.
- D. Repair defective areas, except random cracks and single holes not exceeding 1" diameter, by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts and expose reinforcing steel with at least 3/4" clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding compound. Mix patching concrete of same materials to provide concrete of same type or class as original concrete. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
- E. Notify Construction Manager of all structural repairs. Repair using specified epoxy adhesive and mortar.

- G. Repair methods not specified above may be used, subject to acceptance of Construction Manager.

### 3.17 QUALITY CONTROL TESTING DURING CONSTRUCTION

- A. Construction Manager to employ a testing laboratory to perform tests and to submit test reports.
- B. Sampling and testing for quality control during placement of concrete may include the following, as directed by Construction Manager.
- C. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.
1. Slump: ASTM C 143; one test at point of discharge for each compressive test set; additional tests when concrete consistency seems to have changed.
  2. Air Content: ASTM C 173, volumetric method for lightweight or normal weight concrete; ASTM C 231 pressure method for normal weight concrete; one for each day's pour of each compressive test set.
  3. Concrete Temperature: Test hourly when air temperature is 40 deg F (4 deg C) and below, and when 80 deg F (27 deg C) and above; and each time a set of compression test specimens made.
  4. Compression Test Specimen: ASTM C 31; one set of 4 standard cylinders for each compressive strength test, unless otherwise directed. Mold and store cylinders for laboratory cured test specimens except when field-cure test specimens are required.
  5. Compressive Strength Tests: ASTM C 39; one set for each day's pour exceeding 5 cu. yds. plus additional sets for each 50 cu. yds. over and above the first 25 cu. yds. of each concrete class placed in any one day; one specimen tested at 7 days, two specimens tested at 28 days, and one specimen retained in reserve for later testing if required.
  6. When frequency of testing will provide less than 5 strength tests for a given class of concrete, conduct testing from at least 5 randomly selected batches or from each batch if fewer than 5 are used.
  7. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.
  8. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength test results equal or exceed specified compressive strength, and no individual strength test result falls below specified compressive strength by more than 500 psi.
- B. Report test results in writing to Construction Manager, and Subcontractor within 24 hours after tests. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days,

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concrete mix proportions and materials; compressive breaking strength and type of break for both 7-day tests and 28-day tests.

- C. **Nondestructive Testing:** Impact hammer, sonoscope, or other nondestructive device may be permitted but shall not be used as the sole basis for acceptance or rejection.
- D. **Additional Tests:** The testing service will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by Construction Manager. Testing service may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed. Subcontractor shall pay for such tests when unacceptable concrete is verified.

END OF SECTION

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SECTION 05120

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STRUCTURAL STEEL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Structural Steel Framing.
2. Grouting of Structural Steel Baseplates.
3. Furnishing anchor bolts for embedment in concrete.

B. Related Work In Other Sections:

1. Miscellaneous Metal Fabrications.
2. Steel Grating.
3. FRP Grating.
4. Setting anchor bolts in concrete.

1.2 DESCRIPTIONS

A. Design of Members and Connections: Details shown are typical; similar details apply to similar conditions, unless otherwise indicated. Verify dimensions at site whenever possible without causing delay in the work.

1. Promptly notify Construction Manager whenever design of members and connections for any portion of structure are not clearly indicated.

1.3 SUBMITTALS

A. Product Data: Laboratory test reports and other data to show compliance with specifications (including specified standards).

B. Shop Drawings: Shop drawings to be prepared under supervision of registered professional engineer and to include:

1. Diagrams for assembly of members with setting drawings, templates, and directions for installation of anchor bolts and other anchorages to be installed as work of others sections.
2. Details of cuts, connections, holes, and other pertinent data.
3. Show size, length, and type of each welds by standard AWS A2.1 and A2.4 symbols.

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10-D-9 Test Reports: Submit copies of reports of tests conducted on shop and field bolted and welded connections. Include data on type of tests conducted and test results.

#### 1.4 QUALITY ASSURANCE

A. Codes and Standards: Comply with provisions of following, except as otherwise indicated:

1. AISC "Code of Standard Practice for Steel Buildings and Bridges".
  - a. Paragraph 4.2.1 of the above code is hereby modified by deletion of the following sentence: "This approval constitutes the owner's acceptance of all responsibility for the design adequacy of any connections designed by the fabricator as a part of his preparation of these shop drawings".
2. AISC "Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings", including "Commentary" and Supplements thereto as issued.
3. AISC "Specifications for Structural Joints using ASTM A 325 or A 490 Bolts" approved by the Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation.
4. American Welding Society (AWS) D1.1 "Structural Welding Code - Steel".
5. ASTM A 6 "General Requirements for Delivery of Rolled Steel Plates, Shapes, Sheet Piling and Bars for Structural Use".

B. Qualifications for Welding Work: Qualify welding processes and welding operators in accordance with AWS "Standard Qualification Procedure".

1. Provide certification that welders to be employed in work have satisfactorily passed AWS qualification tests.
  - a. If recertification of welders is required, retesting will be Subcontractor's responsibility.
2. Source Quality Control: Materials and fabrication procedures are subject to inspection and tests in mill, shop, and field, conducted by a qualified inspection agency. Such inspections and tests will not relieve Subcontractor of responsibility for providing materials and fabrication procedures in compliance with specified requirements.
  - a. Promptly remove and replace materials or fabricated components which do not comply.

C. Obtain FEMP work permit before doing any welding or flame cutting.

#### 1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to site at such intervals to insure uninterrupted progress of work.

- B. Deliver anchor bolts, which are to be embedded in cast-in-place concrete, in ample time to not to delay work.
- C. Store materials to permit easy access for inspection and identification. Keep steel members off ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. **Metal Surfaces:** For fabrication of work which will be exposed to view, use only materials which are smooth and free of surface blemishes including pitting, rust and scale seam marks, roller marks, rolled trade names and roughness. Remove such blemishes by grinding, or by welding and grinding, prior to cleaning, treating and application of surface finishes.
- B. **Structural Steel Shapes, Plates and Bars:** ASTM A 36.
- C. **Steel Pipe:** ASTM A 53, Type E or S, Grade B; or ASTM A 501.
- D. **Fasteners:**
  - 1. **Anchor Bolts:** ASTM A 307, nonheaded type unless otherwise indicated.
  - 2. **High-Strength Threaded Fasteners:** Heavy hexagon structural bolts, heavy hexagon nuts, and hardened washers, as follows:
    - a. Quenched and tempered medium-carbon steel bolts, nuts and washers, complying with ASTM A 325.
    - b. Direct tension indicator washers may be used at Subcontractor's option.
- E. **Electrodes for Welding:** Comply with AWS Code.

### 2.2 FABRICATION

- A. **Shop Fabrication and Assembly:** Fabricate and assemble structural assemblies in shop to greatest extent possible. Fabricate items of structural steel in accordance with AISC Specifications and as indicated on final shop drawings.
- B. Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence which will expedite erection and minimize field handling of materials.
- C. Where finishing is required, complete assembly, including welding of units, before start of finishing operations. Provide finish surfaces of members exposed in final structure free of markings, burrs, and other defects.
- D. **Connections:** Weld or bolt shop connections, as indicated.

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- E. Bolt field connections, except where welded connections or other connections are indicated.
  - 1. Provide high-strength threaded fasteners for bolted connections.
- F. High-Strength Bolted Construction: Install high-strength threaded fasteners in accordance with AISC "Specifications for Structural Joints using ASTM A 325 or A 490 Bolts".
- G. Welded Construction: Comply with AWS Code for procedures, appearance and quality of welds, and methods used in correcting welding work.
- H. Holes for Other Work: Provide holes required for securing other work to structural steel framing, and for passage of other work through steel framing members, as shown on final shop drawings.
- I. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame cut holes or enlarge holes by burning. Drill holes in bearing plates.

### 2.3 SHOP PAINTING

- A. Shop paint structural steel.
  - 1. Do not paint surfaces which are to be welded.
  - 2. Apply 2 coats of paint to surfaces which are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.
- B. Surface Preparation: After inspection and before shipping, clean steelwork to be painted. Remove loose rust, loose mill scale, and spatter, slag or flux deposits. Clean steel in accordance with Steel Structures Painting Council (SSPC) as follows:
  - 1. SP-3 "Power Tool Cleaning".
- C. Structural Steel Primer Paint:
  - 1. Non-lead, non-chromate universal primer.
    - a. Acceptable products:
      - 1. Porter Paint Co.: Gray universal primer.
      - 2. Sherwin-Williams: B50 N6 universal metal primer.
      - 3. Glidden: 5210 universal metal primer.
- D. Painting:
  - 1. Immediately after surface preparation, apply structural steel primer paint in accordance with manufacturer's instructions and at a rate to provide dry film thickness of not less than 1.5 mils. Use painting methods which result in full coverage of joints, corners, edges and exposed surfaces.

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## 2.4 GROUT

- A. **Non-metallic Shrinkage-Resistant Grout:** Pre-mixed, non-metallic, non-corrosive, non-staining product containing selected silica sands, portland cement, shrinkage compensating agents, plasticizing and water reducing agents, complying with CE-CRD-C621.
1. **Acceptable Products:**
    - a. Euco N.S.; Euclid Chemical Co.
    - b. Crystex; L&M Construction Chemicals.
    - c. Masterflow 713; Master Builders.
    - d. Five Star Grout; U.S. Grout Corp.

## PART 3 - EXECUTION

### 3.1 ERECTION

- A. **Temporary Bracing:** Provide temporary guy lines to achieve proper alignment of structures as erection proceeds.
- B. **Setting Bases and Bearing Plates:** Clean concrete bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean bottom surface of base and bearing plates.
- C. Set base plates and bearing plates for structural members on wedges or other adjusting devices.
- D. Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims, but if protruding, cut off flush with edge of base or bearing plate prior to packing with grout.
- E. Pack grout solidly between bearing surfaces and bases or plates to ensure that no voids remain. Finish exposed surfaces, protect installed materials, and allow to cure.
1. For proprietary grout materials, comply with manufacturer's instructions.
- F. **Field Assembly:** Set structural frames accurately to lines and elevations indicated. Align and adjust various members forming part of complete frame or structure before permanently fastening. Clean bearing surfaces and other surfaces which will be in permanent contact before assembly. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
- G. Level and plumb individual members of structure within specified AISC tolerances.
- H. Comply with AISC Specifications for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.

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- I. Do not enlarge unfair holes in members by burning or by use of drift pins, except in secondary bracing members. Ream holes that must be enlarged to admit bolts.
- J. Gas Cutting: Do not use gas cutting torches in field for correcting fabrication errors in primary structural framing. Cutting will be permitted only on secondary members which are not under stress, as acceptable to Construction Manager. Finish gas-cut sections equal to a sheared appearance when permitted.
- K. Touch-Up Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint. Apply paint to exposed areas using same material as used for shop painting.
- L. Apply by brush or spray to provide minimum dry film thickness of 1.5 mils.

### 3.2 QUALITY CONTROL

- A. The Construction Manager will engage an independent testing and inspection agency to inspect high-strength bolted connections and welded connections and to perform tests and prepare test reports.
- B. Testing agency shall conduct and interpret tests and state in each report whether test specimens comply with requirements, and specifically state any deviations therefrom.
- C. Provide access for testing agency to places where structural steel work is being fabricated or produced so that required inspection and testing can be accomplished.
- D. Testing agency may inspect structural steel at plant before shipment; however, the Construction Manager reserves right, at any time before final acceptance, to reject material not complying with specified requirements.
- E. Correct deficiencies in structural steel work which inspections and laboratory test reports have indicated to be not in compliance with requirements. Perform additional tests, at Subcontractor's expense, as may be necessary to reconfirm any non-compliance of original work, and as may be necessary to show compliance of corrected work.

END OF SECTION

SECTION 05500

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METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Rough hardware.
2. Steel grating.
3. Install salvaged steel ladder with new steel safety cage.
4. Miscellaneous steel trim.
5. Manhole ladder rungs.

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

1. Demolition.
2. Concrete.
3. Pre-engineered building.
4. Fiberglass reinforced plastic grating.
5. Structural Steel.

1.2 SYSTEM PERFORMANCE REQUIREMENTS

- A. Structural Performance: Design, engineer, fabricate, and install metal fabrications to withstand structural loads without exceeding the allowable design working stress of the materials involved, including anchors and connections. Apply each load to produce the maximum stress in each respective component of each metal fabrication.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product data for products used in miscellaneous metal fabrications, including paint products and grout.
- C. Shop drawings detailing fabrication and erection of each metal fabrication indicated. Include plans, elevations, sections, and details of metal fabrications and their connections. Show

anchorage and accessory items. Provide templates for anchors and bolts specified for installation under other sections.

- D. Obtain FEMPC work permit before doing any welding or flame cutting.
- E. Welder certificates signed by Subcontractor certifying that welders comply with requirements specified under "Quality Assurance" article.

#### 1.4 QUALITY ASSURANCE

- A. Fabricator Qualifications: Firm experienced in successfully producing metal fabrications similar to that indicated for this Project.
- B. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel," D1.3 "Structural Welding Code - Sheet Steel", and D1.2 "Structural Welding Code - Aluminum."

#### 1.5 PROJECT CONDITIONS

- A. Field Measurements: Check actual locations of walls and other construction to which metal fabrications must fit, by accurate field measurements before fabrication; show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress and other related trades.

### PART 2 - PRODUCTS

#### 2.1 FERROUS METALS

- A. Metal Surfaces, General: For metal fabrications exposed to view upon completion of the Work, provide materials selected for their surface flatness, smoothness, and freedom from surface blemishes. Do not use materials whose exposed surfaces exhibit pitting, seam marks, roller marks, rolled trade names, roughness, and, for steel sheet, variations in flatness exceeding those permitted by reference standards for stretcher-leveled sheet.
- B. Steel Plates, Shapes, and Bars: ASTM A 36.
- C. Steel Bars for Gratings: ASTM A 569 or ASTM A 36.
- D. Wire Rod for Grating Cross Bars: ASTM A 510.
- E. Gray Iron Castings: ASTM A 48, Class 30.
- F. Malleable Iron Castings: ASTM A 47, Grade 32510.
- G. Cast Iron Manhole Ladder Rungs: Neenah R-1982-J, or equal. Ductile Iron.

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- H. Concrete Inserts: Threaded or wedge type; galvanized ferrous castings, either malleable iron, ASTM A 47, or cast steel, ASTM A 27. Provide bolts, washers, and shims as required, hot-dip galvanized per ASTM A 153.
- I. Welding Rods and Bare Electrodes: Select in accordance with AWS specifications for the metal alloy to be welded.

## 2.2 FASTENERS

- A. General: Provide zinc-coated fasteners for exterior use or where built into exterior walls. Select fasteners for the type, grade, and class required.
- B. Bolts and Nuts: Regular hexagon head type, ASTM A 307, Grade A.
- C. Lag Bolts: Square head type, FS FF-B-561.
- D. Machine Screws: Cadmium plated steel, FS FF-S-92.
- E. Wood Screws: Flat head carbon steel, FS FF-S-111.
- F. Plain Washers: Round, carbon steel, FS FF-W-92.
- G. Drilled-In Expansion Anchors: Expansion anchors complying with FS FF-S-325, Group VIII (anchors, expansion, [nondrilling]), Type I (internally threaded tubular expansion anchor); and machine bolts complying with FS FF-B-575, Grade 5.
- H. Toggle Bolts: Tumble-wing type, FS FF-B-588, type, class, and style as required.
- I. Lock Washers: Helical spring type carbon steel, FS FF-W-84.
- J. Steel Grating: All sections of steel grating to be removable. Fasten with manufacturer's standard clips and bolts, all galvanized. Provide special grating section at ladder access to concrete pit.

## 2.3 PAINT

- A. Shop Primer for Ferrous Metal: Manufacturer's or fabricator's standard, fast-curing, chromate and lead-free, universal modified alkyd primer selected for good resistance to normal atmospheric corrosion, for compatibility with finish paint systems indicated, and for capability to provide a sound foundation for field-applied topcoats.
- B. Galvanizing Repair Paint: High zinc dust content paint for regalvanizing welds in galvanized steel, with dry film containing not less than 94 percent zinc dust by weight, and complying with DOD-P-21035 or SSPC-Paint-20.
- C. Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint 12 except containing no asbestos fibers.

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2.4 FABRICATION, GENERAL

- A. Form metal fabrications from materials of size, thickness, and shapes indicated but not less than that needed to comply with performance requirements indicated. Work to dimensions indicated or accepted on shop drawings, using proven details of fabrication and support. Use type of materials indicated or specified for various components of each metal fabrication.
- B. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.
- C. Shear and punch metals cleanly and accurately. Remove burrs.
- D. Ease exposed edges to a radius of approximately 1/32 inch, unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- E. Remove sharp or rough areas on exposed traffic surfaces.
- F. Weld corners and seams continuously to comply with AWS recommendations and the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing and contour of welded surface matches those adjacent.
- G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of type indicated or, Phillips flat-head (countersunk) screws or bolts. Locate joints where least conspicuous.
- H. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to provide adequate support for intended use.
- I. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- J. Cut, reinforce, drill and tap miscellaneous metal work as indicated to receive finish hardware, screws, and similar items.
- K. Fabricate joints that will be exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate.

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## 2.5 ROUGH HARDWARE

- A. Furnish bent or otherwise custom fabricated bolts, plates, anchors, hangers, dowels, and other miscellaneous steel and iron shapes as required for framing and supporting woodwork, and for anchoring or securing woodwork to concrete or other structures. Straight bolts and other stock rough hardware items are specified in Division 6 sections.
- B. Fabricate items to sizes, shapes, and dimensions required. Furnish malleable-iron washers for heads and nuts which bear on wood structural connections; elsewhere, furnish steel washers.

## 2.6 STEEL LADDERS

- A. General: Fabricate safety cage for salvaged ladder for the locations shown, with details and anchorages as required.
- B. Coordinate installation of ductile ladder rungs with concrete construction.
- C. Support ladder at top and bottom by means of welded or bolted steel brackets.
  - 1. Size brackets to support design dead and live loads indicated and to hold centerline of treads clear of the wall surface by not less than 7 inches.

## 2.7 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports for applications indicated or which are not a part of structural steel framework, as required to complete work.
- B. Fabricate units to sizes, shapes, and profiles indicated and required to receive adjacent other construction retained by framing and supports. Fabricate from structural steel shapes, plates, and steel bars of welded construction using mitered joints for field connection. Cut, drill, and tap units to receive hardware, hangers, and similar items.

## 2.8 MISCELLANEOUS STEEL TRIM

- A. Provide shapes and sizes indicated for profiles shown. Unless otherwise indicated, fabricate units from structural steel shapes, plates, and steel bars, with continuously welded joints and smooth exposed edges. Use concealed field splices wherever possible. Provide cutouts, fittings, and anchorages as required for coordination of assembly and installation with other work.

## 2.9 METAL BAR GRATINGS

- A. General: Produce metal bar gratings that comply with the following:
  - 1. Metal Bar Grating Standard "Standard Specifications for Metal Bar Grating and Metal Bar Grating Treads" published in ANSI/NAAMM A202.1 "Metal Bar Grating Manual."
- B. Fabricate welded steel gratings to comply with requirements indicated below:
  - 1. Galvanized steel grating with bearing bars and cross bars, bearing bar sizes as indicated.

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- C. Traffic Surface for Steel Bar Gratings:
  - 1. Plain.
- D. Steel Finish:
  - 1. Hot-dip galvanized with a coating weight of not less than 1.8 oz. per sq. ft. of coated surface.
- E. Fabricate cutouts in grating sections for penetrations indicated. Arrange layout of cutouts to permit grating removal without disturbing items penetrating gratings.
  - 1. Edge band openings in grating that interrupt 4 or more bearing bars with bars of same size and material as bearing bars.
  - 2. Do not notch bearing bars at supports to maintain elevation.
- G. Acceptable Manufacturers:
  - 1. Alabama Metal Industries Corp.
  - 2. Barnett/Bates Corp.
  - 3. Blaw-Knox Grating Div., Blaw-Knox Corp.
  - 4. IKG Industries.
  - 5. Klemp Corp.
  - 6. Ohio Gratings, Inc.
  - 7. Reliance Steel Products, Inc.
  - 8. Seidelhuber Metal Products, Inc.
  - 9. Truweld, Inc.

#### 2.10 CAST IRON LADDER RUNGS

- A. Neenah Foundry Company, Model R-1982-J, or equal.
  - 1. Width: 18 inches.
  - 2. Projection: 7 inches.
  - 3. Material: Ductile iron.
- B. Ladder rung to be suitable for casting into concrete.

#### 2.11 FINISHES, GENERAL

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- A. Comply with NAAMM "Metal Finishes Manual" for recommendations relative to application and designations of finishes.
- B. Finish metal fabrications after assembly.

## 2.12 STEEL AND IRON FINISHES

- A. Galvanizing: For those items indicated for galvanizing, apply zinc-coating by the hot-dip process compliance with the following requirements:
  - 1. ASTM A 153 for galvanizing iron and steel hardware.
  - 2. ASTM A 123 for galvanizing both fabricated and unfabricated iron and steel products made of uncoated rolled, pressed, and forged shapes, plates, bars, and strip 0.0299 inch thick and heavier.
- B. Preparation for Shop Priming: Prepare uncoated ferrous metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed metal fabrications:
  - 1. Exteriors (SSPC Zone 1B): SSPC-SP6 "Commercial Blast Cleaning."
  - 2. Interiors (SSPC Zone 1A): SSPC-SP3 "Power Tool Cleaning:"
- C. Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finish or to be embedded in concrete. Comply with requirements of SSPC-PA1 "Paint Application Specification No. 1" for shop painting.
  - 1. Stripe paint all edges, corners, crevices, bolts, welds, and sharp edges.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, including concrete inserts, sleeves, anchor bolts, and miscellaneous items having integral anchors that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.

### 3.2 INSTALLATION, GENERAL

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction; include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws, and other connectors as required.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installation of miscellaneous metal fabrications. Set metal fabrication accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

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- C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete.
- D. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade the surfaces of exterior units which have been hot-dip galvanized after fabrication, and are intended for bolted or screwed field connections.
- E. Field Welding: Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance and quality of welds made, methods used in correcting welding work, and the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing and contour of welded surface matches those adjacent.

### 3.3 ADJUSTING AND CLEANING

- A. Touch-Up Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 requirements for touch-up of field painted surfaces.
  - 1. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. For galvanized surfaces clean welds, bolted connections and abraded areas and apply galvanizing repair paint to comply with ASTM A 780.

END OF SECTION

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SECTION 06610

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FIBERGLASS REINFORCED PLASTIC GRATING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Glass fiber reinforced resin grating of sizes indicated on the drawings to complement existing.

B. Related Work in Other Sections:

1. Steel bar grating.
2. Structural steel supports.

1.2 DESCRIPTION

A. Design grating and support system for support of 150#/S.F.

B. Allowable deflection: 1/4".

1.3 REFERENCES

- A. ASTM D 635 - Test Method for Rate of Burning and/or Extent and Time of Burning Self-Supporting Plastics in a horizontal Position.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's catalogue cuts and literature including load tables and installation instructions.

B. Shop Drawings: Submit shop drawing indicating panel dimensions and layout.

1.5 QUALITY ASSURANCE

- A. Surface Burning Characteristics: Provide grating which are identical in composition to those with surface burning characteristics indicated below, as determined by testing in compliance with ASTM D 635.

1.5 DELIVERY STORAGE AND HANDLING

A. Package materials to protect from damage during delivery.

B. Store materials off ground on pallets or other supports.

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**PART 2 - PRODUCTS**

**2.1 ACCEPTABLE PRODUCTS**

- A. IMCO Reinforced Plastics, Inc.
- B. Chemgrate.
- C. Fibergrate.
- D. Frameline, Ryerson Plastics Division, or equal.

**2.2 MATERIALS**

**A. Grating:**

- 1. Single piece molded fiberglass reinforced thermosetting polymer resin panel.
  - a. Resin: Poly ester.
  - b. Resin Content: Not less than 60 percent.
  - c. Glass Content: Not more than 40 percent.
- 2. Surface to complement existing.
- 3. Sizes:
  - a. Open Surface: 70% to 50%
  - b. Thickness: 1" to 1-1/2".
  - c. Pattern: 1-1/2" sq. or 1" by 6".

- B. Accessories: Stainless steel hold-down clips and bolts.

**2.3 FABRICATION**

- A. Divide grating into sections only to extent necessary for installation.
- B. Fabricate accurately to size with ends and openings for penetrations netly cut and banded. Seal cut surfaces with polyester resin.

**PART 3 - EXECUTION**

**3.1 PREPARATION**

- A. Inspect supports for placement free of rack and even installation.

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3.2 INSTALLATION

- A. Install grating free of rack and level with adjacent floor and grating.
- B. Fit grating to form 1/4" joints between panels, and 1/2" joints at other materials.
- C. Seal all field cuts with polyester resin recommended by grating manufacturer.

END OF SECTION

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SECTION 07110

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SHEET MEMBRANE WATERPROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Waterproofing for the exterior of below-grade concrete Valve House pit selected from one of the following:
  - a. Butyl sheet waterproof membranes.
  - b. Rubberized asphalt sheet waterproofing.
  - c. Protection board and other accessories.

B. Related Work in Other Sections:

1. Vapor Barrier.
2. Concrete.

1.2 SUBMITTALS

- A. Product data and general recommendations from waterproofing materials manufacturer for types of waterproofing required.

1.3 QUALITY ASSURANCE

- A. Manufacturer: Obtain primary waterproofing materials of each type required from a single manufacturer, to greatest extent possible. Provide secondary materials only as recommended by manufacturer of primary materials.
- B. Installer: Firm with not less than five waterproofing projects similar to requirements for this project with satisfactory in-service performance.
- C. Preinstallation Conference: Prior to installation of waterproofing and associated work, meet at project site with Installer of each component of associated work, and installers of work requiring coordination with waterproofing work. Review material selections and procedures to be followed in performing work. Notify Construction Manager at least 48 hours before initiating meeting.

1.4 PROJECT CONDITIONS

- A. Substrate: Proceed with work after substrate construction, openings, and penetrating work have been completed.

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- B. Weather: Proceed with waterproofing and associated work only when existing and forecasted weather conditions will permit work to be performed in accordance with manufacturers' recommendations and warranty requirements.

#### 1.5 WARRANTY

- A. Special Project Warranty: Submit a written warranty, executed by manufacturer, agreeing to repair or replace sheet membrane waterproofing that fails in materials or workmanship within the specified warranty period. This Warranty shall be in addition to and not a limitation of other rights the Owner may have against the Contractor under the Contract Documents.

1. Warranty period is 5 years after date of substantial completion.

#### PART 2 - PRODUCTS

##### 2.1 BUTYL SHEET WATERPROOFING

- A. Butyl synthetic rubber formed into uniform flexible sheets not less than 60 mils thick, complying with the following:

1. Hardness: 50 to 70 Shore A; ASTM D 2240.
2. Tensile Strength: 1200 psi; ASTM D 412.
3. Ultimate Elongation: 300 percent; ASTM D 412.
4. Brittleness Temperature: minus 40 deg F (minus 40 deg C); ASTM D 746.
5. Tear Resistance: 125 lbs. per lin. inch; ASTM D 624 (Die C).
6. Resistance to Heat Aging: Maximum hardness increase of 15 points, maximum reduction in elongation of 30 percent, and maximum loss of tensile strength of 30 percent (168 hours at 240 deg F, (116 deg C); ASTM D 573.
7. Resistance to Ozone Aging: No cracks for 100 hours' exposure of 10 percent elongated samples at 104 deg F (40 deg C) and 50 pphm ozone; ASTM D 1149.
8. Resistance to Water Absorption: Less than 3.0 percent volume gain after 72 hours of water immersion at 212 deg F (100 deg C); ASTM D 471.

- B. Acceptable Products:

1. Sure-Seal Butyl; Carlisle Syntec Systems.

##### 2.4 RUBBERIZED ASPHALT SHEET WATERPROOFING

- A. Self-adhering membrane of rubberized asphalt integrally bonded to polyethylene sheeting, formed into uniform flexible sheets of not less than 60 mils thick, complying with the following:

1. Tensile Strength: 250 psi min; ASTM D 412.

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2. Ultimate Elongation: 300 percent min; ASTM D 412.
3. Pliability Temperature: minus 25 deg F (minus 32 deg C); ASTM D 146.
4. Hydrostatic Head Resistance: 150 feet min.
5. Water Absorption: Not more than 0.5 percent weight gain after 48 hours of immersion at 70 deg F (21 deg C); ASTM D 570.

**B. Acceptable Products:**

1. Bituthene 4000; W. R. Grace & Co.
2. Duramem 700-SM; Pecora Corporation.
3. Polyguard 650; Polyguard Products, Inc.

**2.5 AUXILIARY MATERIALS**

- A. **Adhesives and Joint Tape:** Provide types of adhesive compound and tapes recommended by waterproofing sheet manufacturer for bonding to substrate (if required), for waterproof sealing of seams in membrane, and for waterproof sealing of joints between membrane and flashings, adjoining surfaces, and projections through membrane.
- B. **Primers:** Provide type of concrete primer recommended by manufacturer of sheet waterproofing material for applications required.
- C. **Flashing Materials:** Provide types of flexible sheet material for flashing as recommended by waterproofing sheet manufacturer.
- D. **Protection Board:** Provide protection board for walls and bottom of pit as recommended by waterproofing sheet manufacturer. Include adhesives recommended by manufacturer.

**PART 3 - EXECUTION**

**3.1 PREPARATION**

- A. Prepare surface in accordance with manufacturer's instructions for surface and as follows:
  1. On horizontal surfaces, below sump bottom, install protection board first.
  2. On vertical foundation walls chip off projections where necessary for proper placement and adhesion of waterproofing sheet. Provide appropriate edge cover, where horizontal and vertical waterproofing sheets meet.
- B. Apply primer to concrete surfaces at rate recommended by manufacturer of primary waterproofing materials. Prime only area that will be covered by waterproofing membrane in same working day; reprime areas not covered by waterproofing membrane within 24 hours.

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### 3.2 INSTALLATION

- A. Install materials in accordance with manufacturer's instructions.
- B. Coordinate installation of waterproofing materials and associated work to provide complete system complying with combined recommendations of manufacturers and installers involved in work. Schedule installation to minimize period of exposure of sheet waterproofing materials.
- C. Seal all projections through membrane and all seams. Bond to vertical surfaces and also, where shown or recommended by manufacturer, bond to horizontal surfaces.
- D. Top Edge Seal: For vertical wall membrane, coordinate proper junction with under-slab vapor barrier installation.
- E. Install protection board over completed membrane and below sump bottom under the membrane, complying with manufacturer's recommendations for both waterproofing sheet and protection course materials.

### 3.3 CLEANING

- A. After completion, remove any masking materials and stains from exposed surfaces caused by waterproofing installation.

### 3.4 PROTECTION

- A. Provide for protection of completed membrane during installation of other materials or processes over membrane and throughout remainder of construction period. Do not allow traffic of any type on unprotected membrane.

END OF SECTION

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SECTION 07900

JOINT SEALERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior joints in vertical surfaces and nontraffic horizontal surfaces.
2. Interior joints in vertical surfaces and horizontal traffic and nontraffic surfaces.
3. Joints of a nature similar to that of joints specified shall be sealed with same sealer, whether indicated on drawings to be sealed or not.

B. Related Work in Other Sections:

1. Sealants for glazing.
2. Sealing joints in exterior metal siding and roofing system, including related metal flashing and trim.

1.2 DEFINITIONS

A. Substrates:

1. Concrete.
2. Metal.

1.3 SUBMITTALS

- A. Product data: Submit for each sealer required. Include instructions for joint preparation and joint sealer application, and certified product test reports.
- B. Samples for Initial Selection Purposes: Manufacturer's standard bead samples consisting of strips of actual products showing full range of colors available, for each product exposed to view.

1.4 QUALITY ASSURANCE

A. Preconstruction Compatibility and Adhesion Testing.

1. Submit joint sealant backings, secondary seals, and miscellaneous materials.
  - a. Perform tests under normal environmental conditions that will exist during actual installation.

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## 1.5 PROJECT CONDITIONS

- A. Environmental Conditions: Do not proceed with installation of sealers under the following conditions:
  - 1. When ambient and substrate temperature conditions are outside the limits permitted by sealer manufacturers.
  - 2. When substrates are wet due to rain, frost, condensation, or other causes.
- B. Joint Dimension Conditions: Do not proceed with installation of sealers when joint dimensions are less than recommended by joint sealer manufacturer for application indicated.
- C. Joint Substrate Conditions: Do not proceed with installation of joint sealers until contaminants capable of interfering with their adhesion are removed from joint substrates.

## 1.6 WARRANTY

- A. Warranty, signed by Contractor and installer, that installation will remain weathertight for a period of 5 years. Contractor and installer agree to repair or replace sealer work that fails to stay weathertight during that period.

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. Provide only products which are recommended and approved by their manufacturer for the specific use to which they are put, and which comply with all requirements of the contract documents.
  - 1. Compatibility: Provide sealers, fillers and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by testing and field experience.
  - 2. Colors of exposed sealers:
    - a. As selected from manufacturer's standard colors.
- B. Elastomeric Sealant Standard: Provide manufacturer's standard chemically curing, elastomeric sealant of base polymer indicated which complies with ASTM C 920 requirements, including those referenced for Type, Grade, Class, and Uses.

### 2.2 ELASTOMERIC JOINT SEALANTS

- A. Chemically curing elastomeric sealant of base polymer indicated, including specific Type, Grade, Class, and Uses indicated, as well as all other requirements specified.
  - 1. Comply with the requirements for the particular use corresponding to the applicable substrate as defined above.

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2.3 Multi-Part Nonsag Urethane Sealant (Type A).

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A. Acceptable Products:

1. "Chem-Calk 500"; Bostik Construction Products Div.
2. "Vulkem 227"; Mameco International, Inc.
3. "Vulkem 922"; Mameco International, Inc.
4. "Dualthane"; W.R. Meadows.
5. "Dynatrol II"; Pecora Corp.
6. "Sikaflex-2c NS"; Sika Corp.
7. "Sonolastic NP 2"; Sonneborn Building Products Div.
8. "Dymeric"; Tremco Inc.

2.4 Multi-Part Pourable Urethane Sealant (Type B).

A. Acceptable Products:

1. "Chem-Calk 550"; Bostik Construction Product Div.
2. "Vulkem 245"; Mameco International, Inc.
3. "Vulkem 255"; Mameco International, Inc.
4. "Pourthane"; W.R. Meadows, Inc.
5. "NR-200 Urexpan"; Pecora Corp.
6. "Sikaflex 2c SL"; Sika Corp.
7. "Sonolastic Paving Joint Sealant"; Sonneborn Building Products.
8. "THC-900"; Tremco Inc.

2.5 JOINT FILLERS AND BACKING

- A. Provide sealant backing of material and type which are nonstaining; are compatible with joint substrates, sealants, primers and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

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- B. Plastic Foam Joint Fillers: Preformed, compressible, resilient, nonwaxing, nonextruding strips of flexible, nongassing plastic foam of material indicated below; nonabsorbent to water and gas; and of size, shape and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
    - 1. Either open-cell polyurethane foam or closed-cell polyethylene foam, unless otherwise indicated, subject to approval of sealant manufacturer, for cold-applied sealants only.
  - C. Bond-Breaker Tape: Polyethylene tape or other plastic tape as recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

## 2.6 MISCELLANEOUS MATERIALS

- A. Primer: Provide type recommended by joint sealer manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint sealer-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Provide nonstaining, chemical cleaners of type which are acceptable to manufacturers of sealants and sealant backing materials, which are not harmful to substrates and adjacent nonporous materials, and which do not leave oily residues or otherwise have a detrimental effect on sealant adhesion or in-service performance.
- C. Masking Tape: Provide nonstaining, nonabsorbent type compatible with joint sealants and to surfaces adjacent to joints.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealers, with Installer present, for compliance with requirements for joint configuration, installation tolerances and other conditions affecting joint sealer performance. Do not proceed with installation of joint sealers until unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealers to comply with recommendations of joint sealer manufacturers and the following requirements:
  - 1. Remove all foreign material from joint substrates which could interfere with adhesion of joint sealer, including dust; paints, except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer; old joint sealers; oil; grease; waterproofing; water repellents; water; surface dirt; and frost.
  - 2. Clean concrete, masonry, unglazed surfaces of ceramic tile and similar porous joint substrate surfaces, by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealers. Remove loose particles remaining from

above cleaning operations by vacuuming or blowing out joints with oil-free compressed air.

3. Remove laitance and form release agents from concrete.
  4. Clean metal, enamel and other nonporous surfaces by chemical cleaners or other means which are not harmful to substrates or leave residues capable of interfering with adhesion of joint sealers.
- B. Joint Priming: Prime joint substrates where indicated or where recommended by joint sealer manufacturer based on preconstruction joint sealer-substrate tests or prior experience. Apply primer to comply with joint sealer manufacturer's recommendations. Confine primers to areas of joint sealer bond, do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces which otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

### 3.3 INSTALLATION

- A. Comply with joint sealer manufacturers' printed installation instructions applicable to products and applications indicated, except where more stringent requirements apply.
- B. Elastomeric Sealant Installation Standard: Comply with recommendations of ASTM C 962 for use of joint sealants as applicable to materials, applications and conditions indicated.
- C. Installation of Sealant Backings: Install sealant backings to comply with the following requirements:
1. Install joint fillers of type indicated to provide support of sealants during application and at position required to produce the cross-sectional shapes and depths of installed sealants relative to joint widths which allow optimum sealant movement capability.
    - a. Do not leave gaps between ends of joint fillers.
    - b. Do not stretch, twist, puncture, or tear joint fillers.
    - c. Remove joint fillers which have become wet prior to sealant application and replace with dry material.
  2. Install bond breaker tape between sealants and joint fillers, compression seals, or back of joints where adhesion of sealant to surfaces at back of joints would result in sealant failure.
- D. Installation of Sealants: Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration, and providing uniform, cross-sectional shapes and depths relative to joint widths which allow optimum sealant movement capability.

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- E. Tooling of Nonsag Sealants: Immediately after sealant application and prior to time skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated, to eliminate air pockets, and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents which discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.
    - 1. Provide concave joint configuration per Figure 6A in ASTM C 962, unless otherwise indicated.

### 3.4 CLEANING

- A. Clean off excess sealants or sealant smears adjacent to joints as work progresses by methods and with cleaning materials approved by manufacturers of joint sealers and of products in which joints occur.

### 3.5 PROTECTION

- A. Protect joint sealers during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealers immediately and reseal joints with new materials to produce joint sealer installations with repaired areas indistinguishable from original work.

### 3.6 SCHEDULE OF JOINT SEALANTS

<u>Joint Type</u>	<u>Sealant Type</u>
Control Joints in Masonry:	A
Interior Joints Between Masonry and Wall Opening Frames:	A
Exterior Joints Between Masonry and Wall Opening Frames:	A
Joints Between Structural Steel or Miscellaneous Metal Items:	A
Joints Between Walls and Piping:	A
Joints Between Concrete and Adjacent Work:	A

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<u>Joint type</u>	<u>Sealant type</u>
Joints Between Flashing and Masonry:	A
Joints Between Top of Concrete Foundation Walls or Other Construction Above:	A
Setting Bed Under Exterior Metal Thresholds:	A
Miscellaneous Openings and Joints in Building Where Required to Make Construction Weathertight:	A
Joints at Penetrations of Walls, Decks and Floors by Ducts, Pipes, Pipe Sleeves and Other Penetrating Items:	A
Concrete Floor Control, Construction, and Expansion Joints:	B

3.7 GUARANTEE

- A. Provide Two (2) Year written guarantee of work performed under this section. Under guarantee, signed by contractor and sealant installer, repair or replace sealants which fail to perform as airtight and watertight joints, or fail in joint adhesion, cohesion, abrasion resistance, weather resistance, extrusion resistance, migration resistance, stain resistance, or general durability.

END OF SECTION

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SECTION 08110

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STEEL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel doors and frames.
2. Preparation of doors and frames for hardware and glazing.
3. Insulated doors.
4. Glass and glazing

B. Related Work in Other Sections:

1. Field Painting.
2. Pre-engineered building.
3. Finish door hardware.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data.

B. Shop Drawings: Submit shop drawings for fabrication and installation of specified items, coordinated with opening schedule included in contract documents.

1. Include details of each frame type, elevations of door design types, conditions at openings, details of construction, location and installation requirements of finish hardware and reinforcements, and details of glass, glazing, joints, and connections. Show anchorage and accessory items.
2. Provide schedule of doors and frames using same reference numbers for details and openings as those on contract drawings.

1.3 QUALITY ASSURANCE

A. Provide products which comply with ANSI/SDI 100 and with other requirements specified herein.

1.4 DELIVERY, STORAGE AND HANDLING

A. Deliver hollow metal work cartoned or crated to provide protection during transit and job storage.

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- B. Inspect hollow metal work upon delivery for damage. Remove and replace damaged items as directed.
- C. Store doors and frames at building site under cover. Place units on minimum 4" high wood blocking. Avoid use of non-vented plastic or canvas shelters. Provide 1/4" spaces between stacked doors to promote air circulation.

## PART 2 - PRODUCTS

### 2.1 ACCEPTABLE MANUFACTURERS

- A. Steel Doors and Frames:
  - 1. Allied Steel Products, Inc.
  - 2. Anweld.
  - 3. Ceco Corp.
  - 4. Curries Mfg., Inc.
  - 5. Fenestra Corp.
  - 6. Phillip Manufacturing Co.
  - 7. Mesker Industries, Inc.
  - 8. Pioneer Bldrs. Products Corp.
  - 9. Steelcraft.
  - 10. Trussbilt, Inc.
  - 11. Republic Builders Products Corp.

### 2.2 MATERIALS

- A. Hot-Rolled Steel Sheets and Strip: Commercial quality carbon steel, pickled and oiled, complying with ASTM A 569 and ASTM A 568.
- B. Cold-Rolled Steel Sheets: Commercial quality carbon steel, complying with ASTM A 366 and ASTM A 568.
- C. Supports and Anchors: Fabricate of not less than 18 gage galvanized sheet steel.
- D. Inserts, Bolts, and Fasteners: Manufacturer's standard units.
  - 1. Hot-dip galvanize items to be built into exterior walls, complying with ASTM A 153, Class C or D as applicable.

E. Shop Applied Paint:

1. Primer: Lead free/chromate free rust-inhibitive paint, either air-drying or baking, suitable as a base for specified finish paints.

2.3 FABRICATION

A. Fabricate steel door and frame units to be rigid, neat in appearance and free from defects, warp or buckle. Wherever practicable, fit and assemble units in manufacturer's plant. Comply with SDI-100 requirements as follows:

1. Exterior Doors: SDI-100, Grade III, extra heavy-duty, Model 2, minimum 16-gage faces.

B. Fabricate exposed faces of doors from only cold-rolled steel.

C. Fabricate frames, concealed stiffeners, reinforcement, edge channels, louvers and moldings from either cold-rolled or hot-rolled steel.

D. Exposed Fasteners: Unless otherwise indicated, provide countersunk flat Phillips heads for exposed screws and bolts, stainless steel for exterior fasteners.

E. Thermal-Rated (Insulating) Assemblies:

1. At exterior locations provide doors which have been fabricated as thermal insulating door and frame assemblies and tested in accordance with ASTM C 236.

- a. Provide thermal-rated assemblies with U factor of 0.24 Btu/(hr x ft sq x degrees F) or better.

F. Finish Hardware Preparation: Prepare doors and frames to receive mortised and concealed finish hardware in accordance with final Finish Hardware Schedule and templates provided by hardware supplier. Comply with applicable requirements of ANSI A115 series specifications for door and frame preparation for hardware.

1. Reinforce doors, and frames to receive surface-applied hardware. Drilling and tapping for surface-applied finish hardware may be done at project site.
2. Locate finish hardware as indicated on final shop drawings or, if not indicated, in accordance with "Recommended Locations for Builder's Hardware", published by Door and Hardware Institute.

G. Glass and Glazing: Provide 1/4 inch thick clear wire glass, glazing tape and silicone glazing sealant.

H. Shop Painting:

1. Clean, treat, and paint exposed surfaces of steel door and frame units.
2. Clean steel surfaces of mill scale, rust, oil, grease, dirt, and other foreign materials before application of paint.

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3. Apply shop coat of prime paint of even consistency to provide a uniformly finished surface ready to receive finish paint.

#### 2.4 STANDARD STEEL DOORS

- A. Provide insulated metal doors of types and styles indicated on drawings or schedules.

#### 2.5 STANDARD STEEL FRAMES

- A. Provide metal frames for doors, of types and styles as shown on drawings and schedules. Conceal fastenings, unless otherwise indicated. Fabricate frames of exterior and frames over 4' wide to be 14-gage.
  1. Fabricate frames with mitered corners, welded construction for exterior applications.
- B. Door Silencers: Except on weatherstripped frames, drill stops to receive 3 silencers on strike jambs of single-swing frames and 2 silencers on heads of double-swing frames.
- C. Plaster Guards: Provide 26 gage steel plaster guards or mortar boxes, welded to frame, at back of finish hardware cutouts where mortar or other materials might obstruct hardware operation and to close off interior of openings.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install standard sheet doors, frames, and accessories in accordance with final shop drawings, manufacturer's data, and as herein specified.
- B. Placing Frames: Comply with provisions of SDI-105 "Recommended Erection Instructions For Steel Frames", unless otherwise indicated.
  1. Place frames prior to construction of enclosing walls. 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.
  2. In masonry construction, locate 3 wall anchors per jamb at hinge and strike levels.
  3. At in-place construction, set frames and secure to adjacent construction with machine screws.
- C. Door Installation:
  1. Fit hollow metal doors accurately in frames, within clearances specified in SDI-100.

#### 3.2 ADJUST AND CLEAN

- A. Prime Coat Touch-Up: Immediately after erection, sand smooth any rusted or damaged areas of prime coat and apply touch-up of compatible air-drying primer.

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- B. Final Adjustments: Check and readjust operating finish hardware items, leaving steel doors and frames undamaged and in complete and proper operating condition.

END OF SECTION

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SECTION 08710

FINISH DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Finish Hardware for power station building, and SWRB valve house as scheduled and/or listed herein under hardware sets:
  - a. Hinges.
  - b. Lock cylinders and keys.
  - c. Lock sets.
  - d. Exit devices.
  - e. Closers.
  - f. Miscellaneous door control devices.
  - g. Protection plates.
  - h. Weatherstripping for exterior doors.
  - i. Astragals or meeting seals on pairs of doors.
  - j. Thresholds.

1.2 QUALITY ASSURANCE

- A. Manufacturer: Obtain each type of hardware (latch and lock sets, hinges, closers, etc.) from a single manufacturer.
- B. Supplier: Have hardware schedule required under submittal requirements prepared by a recognized architectural finish hardware supplier.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturers technical product data for each item of hardware.

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- B. Hardware Schedule: Coordinate hardware with doors, frames and related work.
1. Organize hardware schedule into "hardware sets" indicating every item required for each door or opening including:
    - a. Type, style, function, size and finish of each hardware item.
    - b. Name and manufacturer of each item.
    - c. Explanation of all abbreviations, symbols, codes, etc. contained in schedule.
    - d. Mounting locations for hardware.
    - e. Door and frame sizes and materials.
    - f. Keying information.
  2. Submittal Sequence: Submit schedule at earliest possible date.
  3. Keying Schedule: Submit separate schedule indicating desired keying of locks.
  4. Templates: Furnish hardware templates to each fabricator of doors, frames and other work to be factory-prepared for the installation of hardware.

#### 1.4 PRODUCT HANDLING

- A. Tag each item or package separately, with identification related to final hardware schedule, and include basic installation instructions with each item or package.
- B. Packaging of hardware is responsibility of supplier. As material is received by hardware supplier from various manufacturers, sort and repackage in containers clearly marked to match set numbers of approved hardware schedule.
- C. Inventory hardware jointly with hardware supplier and hardware installer to verify correct count.
- D. Deliver individually packaged hardware items at the proper times to the proper locations (shop or project site) for installation.
- E. Provide secure lock-up for hardware delivered to the project, but not yet installed. Control handling and installation of all hardware items.

### PART 2 - PRODUCTS

#### 2.1 ACCEPTABLE MANUFACTURERS

A. Locks and Latches:

1. Sargent.
2. Schlage.

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3. Best.
  4. Russwin.
- B. Butt Hinges:
1. Hager.
  2. McKinney.
  3. Stanley.
  4. Lawrence.
- C. Exit Devices:
1. Von Duprin.
  2. Monarch.
  3. Sargent.
- D. Overhead Door Closers:
1. LCN.
  2. Dorma.
  3. Sargent.
- E. Silencers:
1. Glynn Johnson.
  2. Ives.
- F. Overhead Stops and Holders:
1. Glynn Johnson.
  2. Sargent.
- G. Flush Bolts:
1. Glynn Johnson.
  2. Ives.
  3. Sargent.

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H. Dustproof Strikes:

1. Glynn Johnson.
2. Ives.
3. Sargent.

I. Automatic Flush Bolts:

1. Glynn Johnson.
2. Ives.
3. Sargent.

J. Coordinators

1. Glynn Johnson.
2. Ives.
3. Quality.

K. Bumpers:

1. Glynn Johnson.
2. Ives.
3. Baldwin.

L. Mop Plates and Kickplates: Brookline Industries.

M. Weather Strips and Thresholds:

1. National Guard Products.
2. Reese.
3. Zero.

2.2 COMPONENTS

A. Hardware throughout to be substantially manufactured, fabricated and assembled, parts well fitted and of easy operation. Cast work to be true, free from seams, blisters or other defects. All lines, edges and ornamental work to be sharp and true.

B. Type and finish of hardware to complement hardware at the FMPC. Finish to be 26D, except as noted.

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C. Doorstops:

1. Provide doorstops for doors as wall conditions warrant. Provide proper anchorage for wall or floor materials.
2. Where doorstops are not feasible provide overhead holder.

D. Door Closers:

1. Provide drop-plates, brackets and inverted mounting for conditions where required, Sargent 1250/1251 Series, or equal.

E. Butt Hinges:

1. Butt hinges ball bearing, flat button top, template 5 knuckles, nonrising pins.
2. Provide nonremovable pins for exterior doors.

F. Flush Bolts:

1. Use extension flush bolt on inactive leaf of pairs of doors requiring locking, complete with dustproof floor strike.

G. Knobs and Escutcheons:

1. All lock trim to complement hardware at the FMPC.

H. Cylinders:

1. Provide appropriate type cylinders for all locks as required by the function of the lock.
2. Test all cylinders and package cylinders with their respective locks.
3. Provide 3 keys for each keyed different set.
4. Provide cylinders with a minimum of 5 pin-tumblers for master or grandmaster keying.
5. Provide cylinders that are compatible with existing FMPC keying system.

I. Strike Plates: Strike plates to be wrought, box type.

J. Kickplates:

1. Size: Width door width less 1" on pull side; less 2" on push side.
  - a. Kickplates: 8" high.
2. Gage: 16.
3. Finish: No. 4 Stainless steel.

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- 4. Bevel plates on 3 sides.
  - K. Silencers: Provide silencers Glynn Johnson GJ 64, or equal, on all hollow metal frames as required, 3 for single doors and 2 for pairs of doors.
  - L. Locksets:
    - 1. Provide heavy-duty cylindrical locksets, Sargent 7 Line, or equal.
    - 2. Locks to have face plates, proper back-set, an antirejection split latch bolt, radius strikes and fit usasi standard cutout.
    - 3. Exterior doors must permit egress from inside at all times.
  - M. Overhead Closers: Provide LCN 1460 series, or equal.
  - N. Exit Devices: Horizontal Bar type, Sargent 6700 Series, or equal.
  - O. Weatherstripping:
    - 1. Perimeter jamb and head weatherstrip for exterior hollow metal doors to be aluminum with closed cell neoprene gasketing material, NGP TM 137A and TM 200A, or equal.
    - 2. Provide stainless steel fasteners for complete installation.
    - 3. Provide astragal weatherstripping on double doors.
  - P. Thresholds:
    - 1. Provide extruded aluminum thresholds, alloy 6063, T-5 hardness, clear anodized finish, grooved 5 inch model as manufactured by National Guard Products or equal.
- 2.3 KEYING SYSTEM
- A. Master Keys:
    - 1. Master key all locks.
    - 2. Grandmaster key all locks. (To complement existing keying system).
  - B. Construction Cores:
    - 1. Provide construction cores for all cylinders for use during construction period.
    - 2. Deliver permanent cylinders or cores to the job site and upon completion of construction, install them, replacing the construction cores.

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**PART 3 - EXECUTION**

**3.1 PREPARATION**

- A. Factory- or shop-prepare all work for installation of hardware.

**3.2 INSTALLATION**

- A. Follow hardware manufacturer's instructions and recommendations.
- B. Install surface-mounted items after substrates have been completely finished; install recessed items and recessed portions of items before finishes are applied and provide suitable, effective protection.
  - 1. When surface-mounted items are installed before final finish, remove, store, and reinstall, or apply suitable effective protection.
- C. Mount at heights indicated in "Recommended Locations for Builders Hardware for Standard Steel Doors and Frames" by the Door and Hardware Institute.
- D. Set units level, plumb, and true to line and location.
- E. Reinforce substrates as necessary for proper installation and operation.
- F. Set thresholds in full bed of sealant.

**3.3 ADJUSTMENT**

- A. Adjust each operating item of hardware and each door for proper operation and function; replace units which cannot be adjusted to operate freely and smoothly.

**3.4 CLEANING**

- A. Clean adjacent surfaces soiled by hardware installation.

**3.5 CONTRACT CLOSEOUT**

- A. Deliver keys to the Construction Manager.

**3.6 HARDWARE SCHEDULE**

- A. Schedule which follows lists under each item hardware required for one unit of item. Total hardware required must be determined from total number of units listed under each item.
- B. Double Doors:
  - 1. Hinges - 3 pr. butts.
  - 2. Flush Bolts - 1 set.

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3. Overhead Holders - 2.
4. Exit Device - 1 with push bar and thumb-latch handle.
5. Lockset - 1.
6. Threshold - 1.
7. Kickplates.
8. Weatherstripping.

C. Single Door:

1. Hinges - 1-1/2 pr. butts.
2. Exit Device - 1, with lock, push bar, and thumb-latch handle.
3. Closer with hold-open feature - 1.
4. Threshold - 1.
5. Kickplate.
6. Weatherstripping.

END OF SECTION

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SECTION 09815  
EPOXY COATING

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**PART 1 - GENERAL**

**1.1 SUMMARY**

**A. Section Includes:**

1. Interior and exterior coatings:
  - a. High build epoxy coatings.
2. Scope:
  - a. Epoxy coating on concrete pit floors and walls.
  - b. Epoxy coating on ferrous metal in pit area.
  - c. At existing pump pit coat concrete and steel surfaces with resinous coating.
  - d. Chemical resistant sealants and backing materials.

**B. Related Work In Other Sections:**

1. Painting.
2. Concrete.
3. Structural steel.

**1.2 SUBMITTALS**

**A. Product Data:** Submit manufacturer's technical information including basic materials analysis and application instructions for each coating material specified.

1. List each material and cross-reference the specific coating and finish system and application. Identify each material by the manufacturer's catalog number and general classification.

**B. Samples:** Prior to beginning work, furnish color chips for surfaces to be coated. Submit samples for review of color and texture only. Provide a list of material and application for each coat of each finish sample.

1. Provide samples of each color and material to be applied.

1.3 QUALITY ASSURANCE

- A. Single Source Responsibility: Provide primers and undercoat material produced by the same manufacturer as the finish coats.
- B. Coordination of Work: Review sections in which substrate are provided to ensure compatibility of the total systems for various substrates.
  - 1. Notify the Construction Manager of problems anticipated using the coatings systems specified.
- C. Material Quality: Provide the best quality grade of the various coatings as regularly manufactured by acceptable coating manufacturers.
  - 1. Proprietary names used to designate colors or materials are not intended to imply that products of named manufacturers are required to the exclusion of equivalent products of other manufacturers.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the job site in the manufacturer's original, new, unopened packages and containers bearing manufacturer's name and label and the following information:
  - 1. Name or title of material.
  - 2. Manufacturer's name, stock number and date of manufacture.
  - 3. Contents by volume, for major pigment and vehicle constituents.
  - 4. Application instructions.
  - 5. Color name and number.
  - 6. Handling instructions and precautions.
- B. Store materials not in actual use in tightly covered containers at a minimum ambient temperature of 45 deg F (7 deg C) in a well ventilated area.
  - 1. Protect from freezing. Take necessary precautionary measures to ensure that workmen and work areas are adequately protected from fire hazards and health hazards resulting from handling, mixing and application of epoxy wall coating.

1.5 PROJECT CONDITIONS

- A. Apply epoxy wall coating only when the temperature of substrate and surrounding air temperatures are above 45 deg F (7 deg C), unless otherwise permitted by manufacturer's printed instructions.
- B. Do not apply coatings in snow, rain, fog or mist, or when the relative humidity exceeds 85 percent, or at temperatures less than 5 deg F (3 deg C) above the dew point, or to damp or wet

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surfaces unless otherwise permitted by manufacturer's printed instructions. Allow wet surfaces to dry thoroughly and attain the temperature and conditions specified before proceeding with or continuing the coating operation.

1. Work may continue during inclement weather only if areas and surfaces to be covered are enclosed and the temperature within the area can be maintained within limits specified by the manufacturer during application and drying periods.
- C. Do not apply coating to galvanized steel grating and FRP grating.
- D. Verify type and condition of coatings in existing pump pit, and advise Construction Manager prior to start of remedial work.

## PART 2 - PRODUCTS

### 2.1 ACCEPTABLE PRODUCTS

- A. Acceptable Manufacturers:
1. Porter International.
  2. Devoe and Reynolds Co.
  3. The Glidden Company.
  4. Benjamin Moore and Co.
  5. PPG Industries, Pittsburgh Paints.
  6. Pratt and Lambert.
  7. Sherwin-Williams Company.

### 2.2 COATING MATERIALS AND SEALANTS

- A. Coating Types: Coating types specified are from the catalog of Porter. Other manufacturer's material must be equal to the kind and quality listed:

<u>Type</u>	<u>Material Identification</u>
1	MCR-43, two component, polyamide cured, rust inhibitive epoxy primer, 2 mils DFT, 48 percent solids by volume.
2	MCR-43, two component, high-build, polyamide cured high-build, gloss epoxy, 2 mils DFT, 49 percent solids by volume.
3.	767 PVA Sealer, 28 percent solids by volume

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4. Tile-8, high-build polyamine epoxy coating.. 8 mils DFT, 77 percent solids by volume.

B. Remedial coatings: Provide resinous coating of complementary types and apply as recommended by manufacturer, for remedial work at existing pump pit.

C. Coating Schedule

<u>Surface</u>	<u>Type First Coat</u>	<u>Type Second Coat</u>
Ferrous Metal		
Primed	Touch-Up	2
Unprimed	1	2
Concrete	3	4

C. Sealant Types: Provide chemical resistant sealants and backing materials as recommended by the coating and sealant manufacturers.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

A. Examine substrates and conditions under which coating will be performed for compliance with manufacturer's requirements for application of coatings. Start of coating work will be construed as the Applicator's acceptance of surfaces within particular area.

**3.2 PREPARATION**

A. Remove hardware, hardware accessories, plates, machined surfaces, light fixtures, and similar items which are not to be coated, or provide surface-applied protection prior to surface preparation and coating. Remove these items if necessary for complete coating of the items and adjacent surfaces. Following completion of coating operations in each space or area, reinstall items removed, using workmen skilled in the trades involved.

1. Clean surfaces before applying coatings or surface treatments. Schedule cleaning and coating application so dust and other contaminates will not fall on wet, newly coated surfaces.

B. Surface Preparation: Perform surface preparation and cleaning in compliance with the manufacturer's instructions for the particular substrate conditions, and as specified.

1. Notify the Construction Manager in writing of anticipated problems using coatings specified with substrates primed or furnished by others.

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2. **Ferrous Metal Surfaces:** Clean non-galvanized, ferrous metal surfaces, that have not been shop-coated; remove oil, grease, dirt, loose mill scale and other foreign substances. Use solvent or mechanical cleaning methods that comply with the recommendations of the Steel Structures Painting Council.
  - a. Touch-up shop applied prime coats or existing coatings which have been damaged, and bare areas with Porter 4301 grey epoxy primer. Wire-brush, solvent clean, and touch-up with the same primer as the shop coat.
- C. **Material Preparation:** Carefully mix and prepare materials in compliance with the coating manufacturer's directions.
  1. Stir materials before application to produce a mixture of uniform density, and as required during application.

### 3.3 APPLICATION

- A. Apply epoxy coatings by brush, roller, spray, squeegee, or other applicators in accordance with manufacturer's directions. Use brushes best suited for the material being applied. Use rollers of carpet, velvet back, or high-pile sheep's wool as recommended by the manufacturer for the material and texture required.
  1. The number of coats and film thickness required is the same regardless of the application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. Sand between applications where sanding is required to produce an even smooth surface in accordance with the manufacturer's directions.
  2. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, convector covers, covers for finned tube radiation, grilles, and similar components are in place in areas to be coated. Extend coatings in these areas as required to maintain the system integrity and provide desired protection.
- B. **Minimum Coating Thickness:** Apply each material at not thinner than the manufacturer's recommended spreading rate. Provide total dry film thickness of the entire system as specified.
- C. **Prime Coats:** Before application of finish coats, apply a prime coat, as recommended by the manufacturer, to material required to be coated or finished, and which has not been prime coated by others.
  1. Recoat primed and sealed substrates where there is evidence of suction spots or unsealed areas in the first coat, to assure a finish coat with no burn-through or other defects due to insufficient sealing.

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- D. **Mechanical Applications:** Use mechanical methods for coating application when permitted by the manufacturer's recommendations.
  - 1. Wherever spray application is used, apply each coat to provide the equivalent hiding of roller or brush-applied coats. Do not double-back with spray equipment building-up film thickness of 2 coats in one pass, unless recommended by the manufacturer.
- E. **Completed Work:** Match approved samples for color, texture and coverage. Remove, refinish or recoat work not in compliance with specified requirements.

### 3.4 FIELD QUALITY CONTROL

- A. The Construction Manager reserves the right to invoke the following test procedure at any time, and as often as the Owner deems necessary, during the period when coating operations are being conducted.
  - 1. The Construction Manager will engage the services of an independent testing laboratory to sample the coating being used. Samples of material delivered to project site will be taken, identified and sealed, and certified in the presence of the Construction Manager.
  - 2. The testing laboratory will perform appropriate tests for the following characteristics:
    - a. Quantitative materials analysis.
    - b. Absorption.
    - c. Accelerated yellowness.
    - d. Color retention.
    - e. Alkali and mildew resistance.
    - f. Abrasion resistance.
    - h. Washability.
    - i. Recoating.
    - j. Skinning.
  - 3. If results show materials being used do not comply with requirements, the Subcontractor may be directed to remove non-complying materials, pay for testing, recoat surfaces coated with rejected materials, or remove rejected materials from previously coated surfaces.

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3.5 CLEANING

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- A. Clean-Up: At the end of each work day, remove rubbish, empty cans, rags and other discarded materials from the site.
  - 1. Upon completion of work, clean spattered surfaces. Remove spattered coatings by washing, scraping or other proper methods, using care not to scratch or damage adjacent finished surfaces.

3.6 PROTECTION

- A. Protect work of other trades, whether to be coated or not, against damage from coating. Correct damage by cleaning, repairing, replacing, and recoating as acceptable to the Construction Manager. Leave in an undamaged condition.
- B. Provide "Wet Paint" signs to protect newly-coated finishes. Remove temporary protective wrappings provided by others for protection of their work, after completion of coating operations.
  - 1. At completion of construction activities of other trades, touch-up and restore damaged or defaced coated surfaces.

END OF SECTION

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SECTION 09900

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PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Surface preparation, painting, and finishing of exposed interior and exterior items and surfaces.
2. Surface preparation, priming, and finish coats specified in this section are in addition to shop priming and surface treatment specified under other sections.

B. Related Work in Other Sections:

1. Shop priming structural steel.
2. Shop priming fabrications metal.
3. Shop priming steel doors and frames.
4. Prime painting mechanical and electrical work.
5. Factory finishes of pre-engineered building.
6. Epoxy coating.

1.2 DESCRIPTIONS

A. Paint exposed surfaces except where a surface or material is specifically indicated not to be painted. Where an item or surface is not specifically mentioned, paint the same as similar adjacent materials or surfaces. Color or finish will be selected from standard colors or finishes available.

1. Painting includes field painting exposed bare and covered pipes and ducts sprinkler piping-red, hangers, exposed steel and iron work, and primed metal surfaces of mechanical and electrical equipment.

B. Painting is not required on prefinished items, finished metal surfaces, concealed surfaces, operating parts, and labels.

1. Prefinished items not to be painted include the following factory-finished components:
  - a. Finished mechanical and electrical equipment.
  - b. Light fixtures.

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- c. Factory finished or aluminized roof deck of pre-engineered building.
  - d. Vinyl faced insulation of pre-engineered building.
  - e. FRP grating.
3. Finished metal surfaces not to be painted include:
- a. Aluminum.
  - b. Stainless steel.
  - c. Chromium plate.
  - d. Copper.
  - e. Bronze.
  - f. Galvanized grating.
4. Operating parts not to be painted include moving parts of operating equipment such as the following:
- a. Valve and damper operators.
  - b. Linkages.
  - c. Sensing devices.
  - d. Motor and fan shafts.
5. Labels: Do not paint over Underwriter's Laboratories, Factory Mutual or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

### 1.3 DEFINITIONS

- A. "Paint" includes coating systems materials, primers, emulsions, enamels, stains, sealers and fillers, and other applied materials whether used as prime, intermediate, or finish coats.

### 1.4 SUBMITTALS

- A. Product Data: Manufacturer's technical information, label analysis, and application instructions for each material proposed for use, including solids by volume.

- 1. List each material and cross-reference the specific coating and finish system and application. Identify each material by the manufacturer's catalog number and general classification.

- B. Samples for initial color selection in the form of manufacturer's color charts.

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### 1.5 QUALITY ASSURANCE

- A. **Paint Systems:** Provide primers and undercoat paint produced by the same manufacturer as the finish coats.
- B. **Coordination of Work:** Review other sections in which primers are provided to ensure compatibility of the total systems for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
  - 1. Notify the Construction Manager of problems anticipated using the materials specified.
- C. **Material Quality:** Provide the manufacturer's best quality trade sale paint material of the various coating types specified. Paint material containers not displaying manufacturer's product identification will not be acceptable.
  - 1. Proprietary names used to designate colors or materials are not intended to imply that products named are required or to exclude equal products of other manufacturers.

### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to the job site in the manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:
  - 1. Product name or title of material.
  - 2. Product description (generic classification or binder type).
  - 3. Manufacturer's stock number and date of manufacture.
  - 4. Contents by volume, for pigment and vehicle constituents.
  - 5. Thinning instructions.
  - 6. Application instructions.
  - 7. Color name and number.
- B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F (7 deg C). Maintain containers used in storage in a clean condition, free of foreign materials and residue.
  - 1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.

### 1.7 JOB CONDITIONS

- 1. Apply water-based paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 50 deg F (10 deg C) and 90 deg F (32 deg C).

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0225 Apply solvent-thinned paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 45 deg F (7 deg C) and 95 deg F (35 deg C).

3. Do not apply paint in snow, rain, fog, or mist, when the relative humidity exceeds 85 percent, at temperatures less than 5 deg F (3 deg C) above the dew point, or to damp or wet surfaces.
  - a. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by the manufacturer during application and drying periods.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

#### A. Acceptable Manufacturers:

1. Devoe and Reynolds Co.
2. The Glidden Company.
3. Benjamin Moore and Co.
4. PPG Industries, Pittsburgh Paints.
5. Pratt and Lambert.
6. The Sherwin-Williams Company.
7. Porter Paint Co.

### 2.2 PRIMERS

A. Synthetic, Rust-Inhibiting Primer: Quick-drying, rust-inhibiting primer for priming ferrous metal on the exterior under full-gloss and flat alkyd enamel and on the interior under flat latex paint or odorless alkyd semigloss or alkyd gloss enamels:

1. Pittsburgh: 6-208 Red Inhibitive Metal Primer.

B. Universal Metal Primer: Primers used for priming ferrous metals on the exterior under high-gloss alkyd enamels.

1. Pittsburgh: B50N6 Universal Metal Primer.

C. Galvanized Metal Primer: Primer used to prime interior and exterior zinc-coated (galvanized) metal surfaces:

1. Pittsburgh: 6-215/216 Speedhide Galvanized Steel Primer.

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### 2.3 UNDERCOAT MATERIALS

A. Interior Enamel Undercoat: Ready-mixed enamel for use as an undercoat over a primer on ferrous or zinc-coated metal under an interior alkyd semigloss enamel or a full-gloss alkyd enamel:

1. Pittsburgh: 6-6 Speedhide Quick-Dry Enamel Undercoater.

### 2.4 EXTERIOR FINISH PAINT MATERIAL

A. Alkyd Gloss Enamel: Weather-resistant high-gloss enamel for use over exterior primed ferrous metal surfaces:

1. Pittsburgh: 54 Line Quick-Dry Enamel.

B. Deep Color Alkyd Resin Exterior Trim Paint: Deep color, ready-mixed alkyd paint for use on the exterior over prime-coated ferrous metal:

1. Pittsburgh: 1 Line Sun-Proof Deeptone.

C. Alkyd Gloss Enamel: Weather-resistant high-gloss enamel for use over primed, zinc-coated (galvanized) metal surfaces:

1. Pittsburgh: 54 Line Quick-Dry Enamel.

### 2.5 INTERIOR FINISH PAINT MATERIAL

A. Latex-Based Interior Flat Paint: Ready-mixed, latex-based paint for use as a "size" on cotton or canvas covering over insulation:

1. Pittsburgh: 50-35 Latex Ceiling Paint. Latex Paint.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine substrates and conditions under which painting will be performed for compliance with requirements for application of paint.

1. Start of painting will be construed as the Applicator's acceptance of surfaces and conditions within a particular area.

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### PREPARATION

- A. **General Procedures:** Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items in place that are not to be painted, or provide surface-applied protection prior to surface preparation and painting. Remove these items if necessary for complete painting of the items and adjacent surfaces. Following completion of painting operations in each space or area, have items reinstalled by workers skilled in the trades involved.
1. Clean surfaces before applying paint or surface treatments. Remove oil and grease prior to cleaning. Schedule cleaning and painting so that dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
- B. **Surface Preparation:** Clean and prepare surfaces to be painted in accordance with the manufacturer's instructions for each particular substrate condition and as specified.
1. Provide barrier coats over incompatible primers or remove and reprime. Notify Construction Manager in writing of problems anticipated with using the specified finish-coat material with substrates primed by others.
  2. **Ferrous Metals:** Clean nongalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with recommendations of the Steel Structures Painting Council.
    - a. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by the paint manufacturer, and touch up with the same primer as the shop coat.
  3. **Galvanized Surfaces:** Clean galvanized surfaces with non-petroleum-based solvents so that the surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.
- C. **Materials Preparation:** Carefully mix and prepare paint materials in accordance with manufacturer's directions.
1. Maintain containers used in mixing and application of paint in a clean condition, free of foreign materials and residue.
  2. Stir material before application to produce a mixture of uniform density; stir as required during application. Do not stir surface film into material. Remove film and, if necessary, strain material before using.
  3. Use only thinners approved by the paint manufacturer, and only within recommended limits.
- D. **Tinting:** Tint each undercoat a lighter shade to facilitate identification of each coat where multiple coats of the same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

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### 3.3 APPLICATION

- A. Apply paint in accordance with manufacturer's directions. Use applicators and techniques best suited for substrate and type of material being applied.
- B. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
  - 1. The number of coats and film thickness required is the same regardless of the application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. Sand between applications where sanding is required to produce an even smooth surface in accordance with the manufacturer's directions.
  - 2. Apply additional coats when undercoats, or other conditions show through final coat of paint until paint film is of uniform finish, color, and appearance. Give special attention to ensure that surfaces, including edges, corners, crevices, welds, and exposed fasteners, receive a dry film thickness equivalent to that of flat surfaces.
  - 3. The term "exposed surfaces" includes areas visible when permanent or built-in equipment is in place. Extend coatings in these areas as required to maintain the system integrity and provide desired protection.
  - 4. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
- C. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
  - 1. Allow sufficient time between successive coats to permit proper drying. Do not recoat until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure and where application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.
- D. Minimum Coating Thickness: Apply materials at not less than the manufacturer's recommended spreading rate, but not less than 2 mils DFT for prime coats. Provide a total dry film thickness of the entire system as recommended by the manufacturer.
- E. Mechanical items to be painted include but are not limited to:
  - a. Piping, pipe hangers, and supports.
  - b. Ductwork.
  - c. Insulation.
  - d. Supports.
  - e. Motors and mechanical equipment.

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f. Accessory items.

F. Electrical items to be painted include but are not limited to:

1. Conduit and fittings.
2. Electrical Panels.

G. Prime Coats: Before application of finish coats, apply a prime coat of material as recommended by the manufacturer to material that is required to be painted or finished and has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to assure a finish coat with no burn through or other defects due to insufficient sealing.

I. Pigmented (Opaque) Finishes: Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

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

### 3.4 CLEANING

- A. Cleanup: At the end of each work day, remove empty cans, rags, rubbish, and other discarded paint materials from the site.
- B. Upon completion of painting, clean paint-spattered surfaces. Remove spattered paint by washing and scraping, using care not to scratch or damage adjacent finished surfaces.

### 3.5 PROTECTION

- A. Protect work of other trades, whether to be painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting.
- B. Provide "wet paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others for protection of their work after completion of painting operations.
  1. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

END OF SECTION

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SIGNS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Building Signs.
  - 2. Door Signs.
- B. Related Work In Other Sections:
  - 1. Pre-engineered Metal Building.
  - 2. Metal Doors and Frames.

1.2 SUBMITTALS

- A. Manufacturer's product data for each type of sign.
- B. List of door number and door designation signs.
- C. Illustration of proposed building identification sign.

PART 2 - PRODUCTS

2.1 DOOR NUMBER AND DOOR DESIGNATION SIGN

- A. Plastic signs to be 1/8 inch thick, black, with incised white letters, plain block letters, 3/4 inch high. Signs to be 1-1/2 by 8 inches for doors, with space for six numbers. Door designation signs to be similar, lengths to vary from 8 to 12 inches, to suit room designations.

2.2 BUILDING IDENTIFICATION SIGNS (2 REQUIRED)

- A. Sign Types:
  - 1. Nonilluminated.
  - 2. Exterior.
  - 3. Wall mounted.
- B. Acceptable Manufacturers:
  - 1. Andco.

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2. Architectural Graphics, Inc.
  3. Matthews.
  4. Spanjer.
  5. Supersine.
  6. Vomar or equal.
- C. Sign Framing and Panels:
1. Extruded aluminum perimeter framing, mitered and heliarc welded flat panels with 2 metal faces, front and back. Size to be 72 inches wide by 36 inches high.
  2. Aluminum, 0.090 inch thick.
  3. Front, back panels and four exposed edges.
  4. Aluminum, finish painted as specified.
  5. Sign designations:
    - a. SWRB Valve House  
No. \_\_\_\_\_
  6. Obtain building numbers from operating contractor.
- D. Sign Finishes:
1. Catalyzed polyurethane, white front, black edges.
  2. General appearance of sign to complement other existing similar signs.
- E. Sign Lettering:
1. Provide helvetica medium type style.
  2. Letter type: Painted, black.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Provide mounting accessories and install securely, as required.
- B. Coordinate location of building signs with Construction Manager.
- C. Coordinate spacing of fasteners and mount securely on metal siding panels of prefabricated metal building.

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- D. Room number and room designation signs to be fastened to exterior doors with stainless steel screws.

END OF SECTION

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PRE-ENGINEERED BUILDINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pre-engineered and shop fabricated self-framed steel building for SWRB Valve House.
2. Prefinished wall and roof system.
3. Wall and roof insulation.
4. Exterior doors.
5. Louvers.
6. Enclosure accessories, including metal support hangers for lights and sprinkler pipes, gutters, downspouts, louvers, sealants, and trim.
8. Anchor bolts.

B. Related Work in Other Sections:

1. Concrete Foundations.
2. Concrete Floor slabs.
3. Concrete splash blocks.
4. Wall fans.
5. Mechanical dampers or fans behind louvers.
6. Finish painting of interior and exterior primed steel surfaces of doors and frames , and structural steel framing.
7. Metal fabrications.
8. FRP grating.

1.2 SYSTEM DESCRIPTION

- A. Building Type: The pre-engineered building shall be a single sloped, rigid frame type metal buildings of the nominal length, width, eave height and roof pitch indicated.

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Exterior walls and roofs shall be covered with factory assembled insulated metal wall panels, as shown.

### 1.3 SUBMITTALS

- A. **Product Data:** Submit manufacturer's product information, specifications and installation instructions for building components and accessories.
- B. **Shop Drawings:** Submit complete erection drawings showing anchor bolts settings, sidewall, endwall, and roof framing, transverse cross sections, covering trim details, and accessory installation details to clearly indicate assembly of building components.
- C. **Samples:** Submit color samples for wall and roof panels and trim.

### 1.4 QUALITY ASSURANCE

#### A. Design Criteria:

- 1. **Structural Framing:** Design self-framed exterior covering materials for applicable loads and combinations of loads in accordance with the Metal Building Manufacturers Association's (MBMA) "Design Practices Manual" seismic zone 2 and the Ohio Basic Building Code.
- 2. **Light Gage Steel:** For design of light gage steel members, comply with requirements of the American Iron and Steel Institute's (AISI) "Specification for the Design of Cold Formed Steel Structural Members" and "Design of Light Gage Steel Diaphragms" for design requirements and allowable stresses.
- 3. **Welded connections:** Comply with requirements of the American Welding Society's (AWS) "Standard Code for Arc and Gas Welding in Building Construction" for welding procedures.

#### B. Building Accessories Criteria:

- 1. **Hollow Metal Doors and Frames:** Comply with requirements of the Steel Door Institute's (SDI) "Recommended Specifications for Standard Steel Doors and Frames" (SDI-100) for types and styles and design requirements. Comply with ANSI A115 "Specifications for Door and Frame Preparation for Hardware" for hardware preparation, and applicable specifications of Section 08110-Steel Doors and Frames.
- 2. **Glass:** Glass type, class, quality, style, kind, and form are specified in Section 08110 - Steel Doors. Also comply with recommendations of "Glazing Manual" by Flat Glass Marketing Association.
- 2. **Metal Hangers:** Coordinate hangers for lights and sprinkler pipes with respective trades.

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- C. **Manufacturer's Qualifications:** Pre-engineered metal buildings as produced by a manufacturer with not less than 5 years successful experience in the fabrication of pre-engineered metal buildings of the type and quality required, may be considered, provided building designs of equivalent values can be assured.
- D. **Erector's Qualifications:** Pre-engineered building shall be erected by a firm that has not less than 5 years successful experience in the erection of pre-engineered buildings similar to those required for this project, and that has been approved by the manufacturer of the building system.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store prefabricated components, sheets, panels, and other manufactured items so that they will not be damaged or deformed.
- B. Stack materials on platforms or pallets, covered with tarpaulins or other suitable weathertight ventilated covering. Store metal sheets or panels so that water accumulations will drain freely. Do not store sheets or panels in contact with other materials which might cause staining.

#### 1.6 MAINTENANCE

- A. **Maintenance Stock:** Furnish at least 5% excess over required amount of nuts, bolts, screws, washers, and other required fasteners for each building. Pack in cartons and store on site where directed.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. **Manufacturer:** Subject to compliance with specified requirements, provide the pre-engineered building systems provided by one of the following; a current member in good standing of the Metal Building Manufacturers Association (MBMA).
  1. Varco-Pruden Buildings, AMCA Buildings Division.
  2. Building Technologies Corp., Armco Steelo Building Systems Unit.
  3. Butler Manufacturing Co.
  4. Parkline Inc.
  5. Star Manufacturing Co., H.H. Robertson Co.

#### 2.2 MATERIALS

- A. **Metals:**
  1. **Members Fabricated by Cold Forming:** Comply with requirements of ASTM A607, Grade 50.

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2. Galvanized Steel Sheet: Comply with requirements of ASTM A446 with G90 coating to suit building manufacturer's standards.
3. Bolts: Comply with Requirements of ASTM A307 or A325 as necessary for design loads and connection details.

**B. Glass and Glazing Materials:**

1. Provide glass for doors of quality and type indicated.
2. Glass Types and Qualities:
  - a. Polished Wired Glass: Provide Type III, Class 1, Kind A (flat), Form I, Mesh m1 (welded diamond), nominal 1/4" thick.
3. Glazing Materials:
  - a. Silicone Sealant: Provide single component elastomeric silicone sealant.
  - b. Performed Butyl-Polyisobutylene Glazing Tape: Provide preformed butylpolyisobutylene glazing tape, complying with AAMA 807.1 packaged on rolls with release paper on side, with or without continuous spacer rod.
  - c. Setting Blocks: Provide neoprene, EPDM or silicone setting blocks as required for compatibility with glazing sealants, 80 to 90 Shore A durometer hardness.
  - d. Spacers: Provide neoprene, EPDM or silicone blocks or continuous extrusions, as required for compatibility with glazing sealant, of size, shape and hardness recommended by glass and sealant manufacturer for application indicated.

**D. Thermal Insulation: Provide glass fiber blanket insulation, of not less than 0.5 lb. per cu. ft. density, with UL flamespread classification of 25 or less, 2" wide continuous vapor tight edge tabs.**

1. Vapor Barrier: Vinyl scrim reinforced foil with joint tape as required.
2. Retainer Strips: Provide 26-ga. formed galvanized steel retainer clips colored to match the insulation facing.
3. U-Value Walls: .064.
4. U-Value Roof: .045.

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E. Paint and Coating Materials.

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1. Primers for general ferrous metal:
  - a. Shop Primer for Ferrous Metal: Provide fast-curing, non-chromate lead free, universal primer, as selected by the manufacturer for resistance to normal atmospheric corrosion, compatibility with finish paint systems indicated and capability to provide a sound foundation for field-applied topcoats despite prolonged exposure.
  - b. Shop Primer for Galvanized Metal Surfaces: Provide zinc dust-zinc oxide primer as selected by the manufacturer for compatibility with substrate.
2. Coating Systems for Prefinished Wall and Roof Systems:
  - a. Shop-Primed Exterior Galvanized or Aluminized Metal Wall and Roof Surfaces: Provide manufacturer's standard factory finish, polyester or thermosetting fluoro-polymer. Interior finish to be polyester type, off white color.
  - b. Optional Roof Finish: Unpainted aluminized metal surface.
  - c. Finish Colors: Finishes of walls, roofs, and trim to be selected from manufacturer's standard colors.

2.3 ROOFING AND SIDING PANELS

- A. Provide self-framed pre-engineered pre-formed roofing and siding sheets.
  1. Steel Sheets: Provide either structural quality hot-dip galvanized steel sheets or drawing quality aluminum coated steel sheets.
    - a. Zinc-Coated: Structural quality hot-dip galvanized steel sheets, ASTM A446, Grade C, with G90 coating complying with ASTM A 525.
    - b. Aluminum Coated: Drawing quality aluminum coated steel sheets, complying with requirements of ASTM A 463, with TI-40 coating.
      - 1) Metal thickness not less than 24 ga.
- B. Insulated Wall Panels: Provide field assembled wall panel units. Securely fasten units together with rivets, bolts, studs, "snap-on", or other approved methods of fastening with weathertight seals.
- C. Insulated Roof Panels: Provide manufacturer's standard factory-formed lapped seam roof panel system designed for mechanical attachment of panels using self-framed roof panels for the Valve House.

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- D. **Fasteners:** Provide self tapping screws, bolts, and nuts, self-locking rivets, self-locking bolts, end-welded studs, and other suitable fasteners as standard with the manufacturer designed to withstand design loads.
    - 1. Provide hangers to be supported from roof deck ribs for light fixtures and sprinkler pipes.
  - E. **Accessories:** Provide the following sheet metal accessories factory formed of the same material and finish as the roofing and siding.
    - 1. Flashings.
    - 2. Fillers.
    - 3. Eave covers.
    - 4. Gutters and downspouts.
  - F. **Flexible Closure Strips:** Provide closed-cell, expanded cellular rubber, self-extinguishing flexible closure strips. Cut or premold closure strips to match corrugation configuration of roofing and siding sheets. Provide closure strips where necessary to ensure airtight and weathertight construction.
  - G. **Sealing Tape:** Provide pressure sensitive 100 percent solids grey polyisobutylene compound sealing tape with release paper backing. Provide permanently elastic, non-sag, non toxic, non staining tape not less than 1/2" wide and 1/8" thick.
  - H. **Joint Sealant:** Provide one-part elastomeric polyurethane, polysulfide, or silicone rubber sealant as recommended by the building manufacturer.

## 2.5 STEEL DOORS AND OTHER OPENING FRAMES

- A. Provide steel subframes to accommodate steel doors and frames specified in Section 08110.
- B. Provide steel subframes for side wall louvers, fans and roof curbs, as required.

## 2.6 SHEET METAL ACCESSORIES

- A. **General:**
  - 1. Provide factory coated steel sheet metal fasciae, rake, and eave trim, base channels, panel closures, and other accessories with factory coated steel roofing and siding panels.
- B. **Gutters:** Form gutters in sections not less than 8 feet in length, complete with end pieces, outlet tubes and other special pieces as may be required. Join sections with riveted and soldered or sealed joints. Provide expansion-type slip joint at center of runs. Furnish gutter supports space at 36" o.c., constructed of same metal as gutters. Provide stainless steel wire ball strainers at each outlet.

- C. Downspouts: Form downspouts in sections approximately 10 feet long, complete with elbows and offsets. Join sections with not less than 1-1/2" telescoping joints. Provide fasteners, designed to securely hold downspouts not less than 1" away from walls; locate fasteners at top and bottom and at approximately 5 feet on center in between.
- D. Wall Louvers: Provide 4 inches thick wall louvers for Valve House, of the size and design indicated, fabricated of not less than of 18-ga. steel. Fold or bead blades at edges, set at an angle that will exclude driving rains, and secure to frames by riveting or welding. Finish to match wall panels.
  - 1. Provide flanges on interior face of opening frames where air intake or exhaust louvers are indicated to be connected with mechanically-operated dampers or metal ductwork.
  - 2. Provide bird screens of 1/2" x 1/2" galvanized steel mesh in rewireable frames on exterior face of louvers. Secure screens with clips to ensure ease of removal for cleaning and rewiring. Fabricate screens and frames of same type as metal louvers.

## 2.9 FABRICATION

- A. General: Design prefabricated components and necessary field connections required for erection to permit easy assembly.
  - 1. Clearly and legibly mark each piece and part of the assembly to correspond with previously prepared erection drawings, diagrams and instruction manuals.
- B. Structural Framing: Shop fabricate self-framing components to the indicated size and section complete with base plates, and other fasteners required for erection in place. Provide required holes for anchoring or connections either shop drilled or punched to framing system:
  - 1. Shop Connections: Provide power riveted, bolted or welded shop connections.
  - 2. Field Connections: Provide bolted field connections.
  - 3. Anchor Bolts: Furnish expansion bolts for installation in Concrete.

## PART 3 - EXECUTION

### 3.1 ERECTION

- A. Framing: Erect panel framing self-system true to line, level and plumb, rigid and secure. Level base plates to a true even plane with full bearing to supporting structures. Use a non-shrinking grout to obtain uniform bearing and to maintain level base line elevation.
- B. Connections: Provide base channels and panel caps with tight fitting closures and trim. Locate and space wall opening frames to suit doors, louvers, curbs, and fans as required.

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- C. Bracing: Provide diagonal rod or angle bracing in both roof and sidewalls as required.
    - 1. Where diaphragm strength of roof or wall panels is adequate to resist seismic or wind forces, other forms of bracing will not be required.
  - D. Framed Openings: Provide shapes of proper design and size to reinforce openings and to carry loads and vibrations imposed, including equipment furnished under mechanical work.

### 3.2 ROOFING AND SIDING

- A. General: Arrange and nest sidelap joints so that prevailing winds blow over, not into, lapped joints. Lap ribbed or fluted sheets one full rib corrugation. Apply panels and associated items for neat and weathertight enclosure.
  - 1. Provide weatherseal under eave and side caps. Flash and seal roof panels at eave and rake with rubber, neoprene or other closures.
- B. Roof Panel System:
  - 1. Standing Seam Roof Panel: Fasten roof panels to purlins with concealed clip in accordance with the manufacturer's instructions.
    - a. Install clips at each support using self-drilling fasteners.
    - b. At end laps of panels install tape calk between panels.
- C. Wall Sheets: Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete and elsewhere as necessary for waterproofing. Handle and apply sealant and back-up in accordance with the sealant manufacturer's recommendations.
  - 1. Align bottoms of wall panels and fasten panels with blind rivets, bolts or self-tapping screws. Fasten flashings, trim around openings, and similar elements with self-tapping screws. Fasten opening frames with machine screws or bolts.
  - 2. Install screw fasteners with power tool having controlled torque adjusted to compress neoprene washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
- D. Sheet Metal Accessories: Install gutters, downspouts, louvers, and other sheet metal accessories in accordance with manufacturer's recommendations for positive anchorage to building and weathertight mounting.
- E. Steel Doors and Frames: Install doors and frames straight, plumb and level. Securely anchor frames to building structure. Set units with 1/8" maximum clearance between door and frame at jambs and head, and 3/4" max. between door and floor. Adjust hardware for proper operation. See section 8710 for finish hardware.
- F. Wall Louver and Exhaust Fans: Install wall louvers in accordance with shop drawings. Coordinate wall fan with respective wall opening.

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- G. Thermal Insulation: Install insulation concurrently with installation of roof panels in accordance with manufacturer's published directions. Install blankets straight and true in one-piece lengths with both sets of tabs sealed to provide a complete vapor barrier. Locate insulation on the underside of roof sheets, extending across the top flange of purlin members and held taut and snug to roofing panels with retainer clips. Install retainer strips at each longitudinal joint, straight and taut, nesting with roof rib to hold insulation in place.

### 3.3 FIELD PAINTING

- A. Cleaning and Touch-Up: Prior to application of finish coats, clean component surfaces of matter that could preclude paint bond.
1. Touch up abrasions, marks, skips or other defects to shop-primed surfaces with same type material as shop primer.

END OF SECTION

SECTION 15050

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GENERAL MECHANICAL WORK REQUIREMENTS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. The requirements of this section, as applicable, form a part of all sections of Division 15.

1.2 CODES AND STANDARDS

- A. In addition to compliance with state and local codes, laws and ordinances, equipment, materials and work to conform to applicable standards of NFPA, ANSI, including the codes for pressure piping, NEC, NEMA, UL, local utility companies and other authorities or agencies to which specific reference is made.
- B. Where contract drawings and/or specifications are more strict than, or indicate additional work not required by specified authorities, agencies or any law or ordinance, then contract drawings and specifications govern.
- C. Provide equipment and materials having features and characteristics as required so that the completed facilities comply with all applicable safety requirements, including Federal Occupational Safety and Health Act Standards.
- D. Provide materials and equipment bearing certification of UL where such labels or stamps are required or specified.

1.3 EQUIPMENT COORDINATION SCHEDULE

- A. The Equipment Coordination Schedule in Appendix A lists various items of equipment and designates limits of related work involved. Applicable provisions of Appendix A form a part of all sections of Division 15.
- B. The symbols "H", "I" and "P" in the equipment coordination schedule under the "FIW" columns are to be understood to refer to work specified under other sections of Division 15 of these specifications.

1.4 MANUFACTURERS' NAMES

- A. Listing of a manufacturer's name does not constitute acceptance of that manufacturer's product unless it complies with the standards and detail specifications relating thereto. Deviations in standards and details are to be noted at the time of proposal in accordance with the requirements for substitutions.

1.5 QUALITY ASSURANCE

- A. Subcontractor's quality assurance program to be submitted for approval prior to fabrication, and to include a quality assurance plan, which outlines inspection and test plans, process controls, nondestructive examination, cleaning procedures, reports, records, identification of

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nonconforming condition, control of purchased material, control of special processes, and a handling and shipping procedure. (Refer to Section 01100 of these specifications for standard requirements for FEMP suppliers.)

- B. The Construction Manager to be provided the opportunity to witness any and all tests specified herein. The Construction Manager to be provided the opportunity to witness unit construction. Seven days' notice to be provided to the Construction Manager for all tests at the jobsite. Fourteen days' notice to be provided to the Construction Manager for all tests or unit construction away from the jobsite. All factory specified testing to be accomplished by the Manufacturer at the factory by schedule as required to meet delivery commitments.

#### 1.6 TEST REPORTS

- A. The Subcontractor to submit a completed report on all tests within one week of test completion. Reports to be completed on tests, submitted for approval, and approved by the Construction Manager prior to shipment.

#### 1.7 SUBMITTALS

- A. Shop drawings to include all performance data, operating sound level data, characteristic curve, equipment numbers, equipment weight, purchase order number, material sizes, material thicknesses, dimensions, material types, piping and electrical connection locations, wiring diagrams, and operating data. See reference for standard requirements for FEMP suppliers.
- B. All shop drawings to be approved by the Construction Manager prior to construction or fabrication.
- C. Refer to Section 01100 for additional information and requirements regarding submittals.

#### 1.8 FIELD CONDITIONS

- A. The various trades involved in the project must properly coordinate their work to fit available space. If there is any question as to where system components should be located so that the work of other trades can be properly installed, meet and discuss such questions with the other trades involved, jointly prepare sketches or coordination drawings if necessary, and otherwise coordinate the work. Any work installed in such locations as to prevent other trades from installing their work with reasonable convenience must be relocated without increase in the contract price.
- B. Drawings indicate desired position of equipment and routing of ducts, piping and conduits. If field conditions are encountered which make arrangements indicated impractical or impossible, submit request for deviation in writing, with drawings if required to clarify request. Do not proceed until request is accepted and authorized in writing by the Construction Manager.

**PART 2 - PRODUCTS**

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**2.1 PIPING HANGERS AND SUPPORTS**

**A. General:**

1. Unless otherwise specified, hangers and supports to be Grinnell of figure numbers specified, or equivalent B-Line, Carpenter & Paterson, Modern, or approved equal. (Perforated steel straps will not be permitted.)

**B. Materials:**

1. Steel pipe - 2 inches and smaller, adjustable steel swivel ring hanger, Grinnell Figure 269, or approved equal. 2-1/2 inches and larger, adjustable steel Clevis hanger, Grinnell Figure 260, or approved equal.
2. Floor supports for steel piping 2-1/2 inches and larger, adjustable pipe saddle, Grinnell Figure 264, or approved equal.
3. Supports at walls or columns to be cast-iron or steel brackets, Grinnell Figure 194, 195 or 199, or approved equal.
4. Spring hangers to be of the manufacturer and model numbers shown on the drawings.
5. Hanger rods to be steel, ASTM A 36 or A 307, with sizes corresponding to tappings in hangers.
6. Insulation protection saddles to be similar to Grinnell Figure 161, or approved equal. Manufacturers figure number specified is for 1-1/2 inch thick insulation. Select saddle for full insulation thickness as specified.

**2.2 PIPE SLEEVES**

**A. Pipe sleeves to be in accordance with the following:**

1. Steel pipe, standard weight.

**2.3 SLEEVE SEALS**

**A. Sleeve seals to be of the type specified for the location indicated.**

**B. Where piping passes through sleeves in exterior walls below grade, use Thunderline "Link-Seal," or approved equal, modular mechanical type seal assembly.**

## 2.4 BUILDING ATTACHMENTS

- A. For securing equipment and piping hangers and supports to building construction, attachments to be in accordance with the following:
1. For suspension from new concrete, provide as required, Grinnell Figure 282, B-Line Figure B3014, Carpenter & Paterson Figure 108, or approved equal, steel or malleable iron inserts in poured concrete construction.
  2. For suspension from existing concrete, provide Phillips series S or series F self-drilling expansion anchors or series JS stud anchors, or approved equal. Anchor sizes to be selected by limiting the applied load to 10 percent or less of manufacturer's published pullout ratings.
  3. For suspension from masonry, provide expansion shields, toggle bolts, or lag screws.
  4. For suspension from structural steel, provide beam or channel clamps. For attaching equipment and for piping 3 inches and larger, use locking clips.

## 2.5 GROUT

- A. Grout to be nonshrink, nonferrous, as follow, or approved equal:
1. Masterflow 713 by Master Builders.
  2. Sonnogrout by Sonneborn.
  3. Five Star by U.S. Grout Corp.
  4. Unisorb V-1 by Unisorb Machinery.

## 2.6 CONCRETE WORK

- A. Where poured-in-place concrete is indicated, use concrete conforming to ACI 301, having maximum slump of 4 inches and compressive strength at 28 days of not less than 3,000 PSI. Cement to be Type 1 conforming to ASTM C 150. Exterior concrete to have 4 to 8 percent air entrainment. Coarse aggregate to be No. 57 in accordance with ASTM C 33.
- C. Reinforcing steel to conforming to ASTM A 615.

## 2.7 MISCELLANEOUS MATERIALS

- A. Steel plates, shaped and bars, and connections to be in accordance with provisions of AISC "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings," where applicable.
- B. Structural steel to be in accordance with ASTM A36.
- C. Threaded rods, machine bolts, nuts and washers to be in accordance with ASTM A307.

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2.8 PAINTING MATERIALS

- A. Paint for prime painting to be Porter No. 285 U-Prime Universal Alkyd Primer, or equivalent Glidden, Pratt and Lambert, Sherwin-Williams, or approved equal.

2.9 EQUIPMENT IDENTIFICATION

- A. Name tag to be minimum 20 gage aluminum sheets, with equipment identification. Nomenclature die-stamped into tag. Nomenclature on tag to be the equipment nomenclature used in the specification and on the drawings.

2.10 PIPE IDENTIFICATION

- A. Identification markers to be pressure-sensitive vinyl cloth pipe markers as manufactured by W. H. Brady Co., Milwaukee, Wisconsin, or Kolbi Industries, Chicago, Illinois, or vinyl plastic pipe markers as manufactured by Seton Nameplate Corporation, New Haven, Connecticut, or approved equal. Markers to show piping service and to include arrows to shown normal direction of flow, if applicable. Color of tape, letters and bands to be in accordance with FEMP Color Coding requirements.
- B. Minimum letter size to be as follows:

<u>OD pipe or Insulation Size, Inches</u>	<u>Letter Size, Inches</u>
1-1/4 and smaller	1/2
1-1/2 to 2	3/4
2-1/2 to 6	1-1/4
8 to 10	2-1/2
Larger than 10	3-1/2

- C. Identification nomenclature to be in accordance with nomenclature used on the drawings.

2.11 UNDERGROUND PIPE MARKERS

- A. Underground pipe markers to be permanent, bright-colored, continuous-printed plastic tape, intended for direct-burial service, not less than 6 inches wide by 4 mils thick. Printing on tape to accurately indicate type of buried pipe service.

PART 3 - EXECUTION

3.1 OPERATING CONTRACTOR-FURNISHED MATERIALS

- A. The Operating contractor has made commitments with respect to furnishing materials described as Operating Contractor-furnished in other sections of Division 15. Such items will be available at the jobsite with all material and shipping costs prepaid by the Operating Contractor.

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- B. Receive such material at the jobsite. Assume full responsibility for its proper care, protection handling and storage. Complete assembly of material as required, and install in strict accordance with contract drawings and specifications and any applicable manufacturers' instructions which are acceptable.

### 3.2 REMOVAL, RELOCATION AND/OR MODIFICATION OF EXISTING INSTALLATIONS, SALVAGE AND DISPOSAL

- A. Remove, relocate and/or modify certain existing installations as indicated on the drawings and specified in other sections of Division 15. Complete the work in a neat and workmanlike manner to best suit space conditions, to assure proper operation of each system, with least possible damage to, and interference with, surrounding construction, and using materials specified. At locations where sections of existing work are removed, cap, plug or seal permanently the remaining sections of the work.

### 3.2 GENERAL PIPING REQUIREMENTS

#### A. General:

1. Cut pipes accurately to measurements established at job. Install piping without springing or forcing. Install exposed pipes parallel to building lines. Install vertical pipes plumb. Offset piping to avoid structural and other interferences. Allow ample space around piping for insulation.
2. Where detailed method of installing work is not indicated, install as directed, and in accordance with manufacturer's recommendations.
3. Where Subcontractor-furnished equipment as actually installed requires local piping different from that shown, or requires additional miscellaneous piping, provide such miscellaneous piping and install equipment and piping as required for proper and satisfactory operation.
4. For steel piping, use standard pipe fittings for making changes in direction of piping and for connecting branch lines to mains.
5. For pipeline-mounted instruments and similar components in steel piping, including temperature indicators, thermowells and pressure indicators, provide 3,000 pound threaded Elbolets, 3,000 pound Latrolets, 3,000 pound full couplings or Thredolets, size as required to suit the instrument, or as shown on the drawings. Where insertion wells or elements are used in piping smaller than 3 inch size, provide oversized segment of pipe, minimum 3 inch size, at such locations.
6. Make reductions in pipe size with reducing fittings. Use no bushings. Use concentric reducers on vertical piping. Unless otherwise indicated, use eccentric reducers with straight part on bottom for horizontal piping wherever required to avoid drainage pockets, and with straight part on top for pump suction connections.
7. Support piping close to equipment connections so weight of pipe will not be borne by equipment.

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8. Repair promptly leaks which develop. If leaks develop after insulation is applied, replace insulation in original condition, and paint as necessary to complete repair.

**B. Flanged joints:**

1. Use flanged fittings and connections only where indicated, and at flanged valves and equipment. Provide companion flanges as required.
2. In each flanged joint, provide gasket of type indicated in applicable piping system material schedules.
3. Bolts to conform to ANSI B31.1 and B16.5 for the pressures and temperatures applied to the respective piping system.
4. Apply antiseize thread lubricant compound on bolts when making up joints. Nuts to be uniformly tightened using sufficient torque to prevent leaks without overstressing bolts.

**3.3 VALVES - GENERAL**

- A. Unless otherwise indicated, provide valves to be in accordance with the requirements specified hereinafter.
- B. Valves same size as lines in which they are installed, or as shown on the drawings.
- C. Use gate or ball valves for strainer blowoffs and equipment drains.
- D. Install gate and globe valves with stems in the vertical upright position where possible but in no case lower than horizontal position. Install ball and butterfly valves with stem in the horizontal position. Where locations of valves are not shown in detail, install valves in accessible positions, arranged for easy removal.

**3.4 PIPE WELDING**

- A. Connect by welding all piping, fittings, flanges, and weld-end appurtenances for services for which butt welding is indicated in the piping system material schedules.
- B. Do all welding in accordance with applicable ANSI codes for pressure piping or with any OBBC requirements which supersede it.
- C. Use welding rod of analysis to match pipe.
- D. Welding must be done by acceptable qualified welders. Before doing any pipe welding, submit, for each welder, certification of compliance with Section IX "Welding and Brazing Qualifications of the ASME boiler and Pressure Vessel Code." Certification to consist of ASME form QW-484 "Record of Welder or Welding Operator Qualification Tests," completed by a recognized testing laboratory for the welding process, procedures and materials to be used in the fabrication of piping on this project. Qualification certificates must not be more than one year old.

3.5 PIPING HANGERS AND SUPPORTS

- A. Provide all hangers, supports and bracing required for piping. Select hangers, supports and bracing using a minimum safety factor of five. Calculate loads for operating weight or for weight during hydrostatic pressure test, whichever is greater.
- B. Floor supports for steel piping 2-1/2 inches and larger, use adjustable pipe saddle, specified herein before. For piping 2 inches and smaller, provide U-bolt on structural steel channel secured to floor with angle clip.
- C. Supports at walls or columns to be properly selected to support weight suspended.
- D. Trapeze hangers may be used where parallel pipes are grouped at approximately same elevation. Fabricate of structural steel angles or channels, with rods of sufficient strength to support weight, and of acceptable design. For securing individual pipes on trapeze, use U-bolts.
- E. Roller supports to be provided using adjustable type roll hangers or roll stands where indicated.
- F. Provide turnbuckles where required to adjust pipe elevations.
- G. For insulated piping, provide hanger and support materials similar to those for uninsulated pipe, but with the requirements specified hereinafter.
  - 1. For insulated piping specified in Section 15250 to be sealed for a vaporproof installation, size hanger ring to fit outside of insulation. Copper-plated or plastic coated rings are not required. Provide minimum 18 gage galvanized steel insulation protection shields outside of insulation finish, minimum 12 inches long, centered on hanger, and covering lower 1/3 of the insulation. A circumferential insert of foam glass pipe insulation for each hanger is to be furnished under Section 15250 for installation under Section 15942.
  - 2. Unless otherwise indicated, provide insulation protection saddle at each pipe support in horizontal piping where heat tracing is specified.
- H. Unless otherwise indicated, all piping to have hanger and support spacing in accordance with the following schedule:

<u>Pipe size, Inches</u>	<u>Hanger spacing, Feet (maximum)</u>
1-1/2 to 2-1/2	10
3	12
4 and 5	14
6	17
8	19
10 and 12	22
14, 16 and 18	25
20 and 24	30

- I. For branches 3/4 inch and smaller, provide a hanger not more than 18 inches from end of each horizontal run and from each elbow.

### 3.6 PIPE SLEEVES

- A. Provide pipe sleeve as follows:

1. Steel pipe sleeves for exterior walls above or below grade.

- B. Provide sleeves of the types indicated, centered on pipes through walls, in accordance with the following:

1. Sleeve to be two sizes larger than the pipe.

### 3.7 SLEEVE SEALS

- A. Where piping passes through sleeves in exterior walls above grade, pack void between piping and sleeves, or between pipe insulation and sleeves, with mineral wool. Fill ends of sleeves with silicone foam compound.

- B. Where piping passes through sleeves in exterior walls above below grade, close the annular space between piping and sleeves with modular mechanical type seal assembly. Each seal assembly to be sized as recommended by the manufacturer to fit the pipe and sleeve.

### 3.8 DIRT IN PIPING

- A. Remove dirt, welding spatter, and other substances from pipe, fittings, valves, flanges, and similar items before installation to avoid injury to valves or equipment caused by foreign substances in piping system. Clean out and repair, or replace, such damaged materials as directed.

### 3.9 INSTALLATION OF UNDERGROUND PIPING

- A. General:

1. Drawings indicate approximate location of known existing utility lines and other possible interferences. Where any interference, whether or not shown, is encountered, proceed as indicated or directed.

- B. Excavation:

1. Excavate as required for installation of underground work. Protect excavations and keep them dry at all times. Maintain trench banks as nearly vertical as possible. Do all necessary sheet piling, shoring, bailing and pumping. Spoil excess earth where directed.
2. In filled or backfilled areas within the building limits, install work only after building fill is completely compacted.

3. Unless otherwise indicated, excavate piping trenches 4 to 6 inches below bottom of pipe and provide specified bedding.
4. When measured from final grade, depth of bury or cover over underground construction to be not less than the following, unless otherwise indicated:

<u>Service</u>	<u>Depth, Inches</u>
Fire mains	72
Treated water	48
Ground Water	48
<u>Service</u>	<u>Depth, Inches</u>
Contaminated effluent	48
Outfall Sewer	48

5. Width of excavation at top of pipe not to exceed 2 feet overall or 8 inches either side of work to be placed, whichever is greater.
6. Unless otherwise indicated, place pipes at sufficient distance from building footings or other structure so that slope is not greater than 1 horizontal to 2 vertical between base of excavation and bottom of footings or other structures. Where field conditions or special requirements do not permit performance within these limitations, excavate and backfill as directed.

C. Pipe laying:

1. Provide firm bed, compacted and of materials specified herein for each pipe. Shape bedding to support pipe uniformly along entire bottom quadrant of pipe without resting on bell or joint when brought to grade.
2. Inspect and clean pipes before lowering into trenches. Lay to uniform grade between elevations shown or to pitch indicated. Use electronic beam to establish vertical and horizontal control.
3. Keep water out of pipes until joints have set. Close open ends of piping during construction to prevent earth entering lines. Close stub ends of lines and unused openings in fittings.
4. For water piping, provide concrete thrust blocks or tie-rods and pipe clamps at all tees, plugs, or bends, to resist any thrust that may be encountered. Coat all steel rods and clamps with a heavy coat of asphalt. Install tie-rods and clamps as illustrated in the latest edition of NFPA Standard No. 24. Install thrust blocks between solid ground and the fittings so that the joints will be accessible for inspection and repair.

D. Backfilling:

1. Do not backfill until piping has been inspected and tested as specified under Section 15990. Where required to hold pipe firmly in trench during testing, place backfill over center of each length of pipe keeping joints exposed.

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2. Bed and backfill around pipe and to within 12 inches above the pipe with bank run gravel or sand having a gradation of 100 percent passing the 3/4 inch sieve and not more than 5 percent passing the No. 200 sieve.
3. For piping under paved areas, complete remainder of backfill with bank run gravel.
4. For all other backfill use suitable materials. Material will not be permitted which is frozen or too wet, or contains debris, large clods or large stones, or has been removed as unsuitable. If material which would otherwise be suitable for backfill is frozen or too wet at the time the trenches are scheduled to be backfilled, to avoid delay in other work on the project, backfill with bank run gravel.
5. Unless otherwise indicated, backfill materials to be placed in 6 inch layers, using care to avoid displacing pipe. Power tamp each layer with tamper to 100 percent maximum density for areas under pavement, and 95 percent maximum density for all other areas, as measured by AASHTO T-99, method A or D, standard method of test for compaction and density of soils, as applicable.
6. Repair backfilled areas that settle within one year after final acceptance of the entire work under these specifications including pavement, structures and other facilities damaged as a result of such settlement. Refill, compact and grade settled areas to conform to finished grade elevation. Refill lawn areas with topsoil and sod.

### 3.10 CONCRETE WORK

- A. Construct formwork in accordance with ACI specification 301. Place concrete by methods which will avoid segregation, and thoroughly consolidate. Provide steel trowel finish for all exposed surfaces.

### 3.11 GUARDING

- A. Provide guarding for equipment required to comply with Federal Occupational Safety and Health Act Standards.

### 3.12 INSTALLATION OF EQUIPMENT

#### A. General:

1. Provide bracing and supports required for installation of equipment. Structural steel and steel rod hangers to be rigid and workmanlike in appearance. Select hangers, supports and bracing having a minimum safety factor of five all equipment supports to be designed for use in seismic Zone 2. Weld structural steel hangers, or bolt with hex head machine bolts and with spring lock washers under nuts.
2. Mount and align equipment in accordance with manufacturer's recommendations and in accordance with procedures described herein. Where structural or miscellaneous steel is not drilled in shop, drill in field as directed. Cutting holes in structural steel with torch will not be permitted.

3. Lubricate equipment as required and in accordance with manufacturer's recommendations.
4. Provide all system charges including lubricants and other materials required to place systems into satisfactory operation.

**B. Securing suspended equipment:**

1. For suspension from new concrete, provide as required, steel or malleable iron inserts in poured concrete construction.
2. For suspension from existing concrete, provide self-drilling expansion anchors or stud anchors installed in accordance with manufacturer's instructions. Anchor sizes to be selected by limiting the applied load to 10 percent or less of manufacturer's published pullout ratings.
3. For suspension from masonry, provide expansion shields, toggle bolts, or lag screws. Use electrical drill with carbide bit for drilling concrete blocks.
4. For suspension from structural steel, provide beam or channel clamps with locking clips.
5. Do not suspend hangers from roof deck unless indicated. Unless otherwise indicated, suspension from roof trusses to be made only at panel points.
6. Miscellaneous - provide additional bracing and supports wherever needed. Provide structural steel members attached to building framing, where required, to provide additional points of support. Do no drilling of building structural and miscellaneous steel, except as directed or indicated.

**C. Equipment set on structural steel:**

1. For bolting equipment directly to structural steel, provide machine bolts, lock washers and nuts.

**D. Floor-mounted equipment:**

1. Provide concrete pads as required for mechanical equipment as shown on the drawings. Unless otherwise indicated, concrete pads to be reinforced with 6 by 6 - W2.9 by W2.9 welded wire fabric.
2. Provide anchor bolts, nuts, washers and anchor bolt sleeves required. Provide quantity and size of anchor bolts recommended by equipment manufacturer or otherwise indicated.
3. Provide sleeves of schedule 40 black steel pipe for each anchor bolt set in concrete foundations. Provide pipe sleeve with inside diameter of 2-1/2 times diameter of anchor bolt with which it is used and with length of sleeve equal to vertical length of anchor bolt extending below top of foundation. Top of sleeve not to project above top of rough foundation (bottom of grout.) to assure anchorage in concrete, weld a 1/4 inch thick steel plate, 3 inches square, to bottom of each anchor bolt before setting.

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4. Furnish manufacturer's certified drawings showing anchor bolt settings.
5. Check locations of anchor bolts and sleeves as set in concrete formwork to assure conformance with locations designated on certified drawings.
6. Use steel wedges to level equipment on foundations. Provide steel shim plates at each anchor bolt to maintain leveled position of equipment. Position shim plates so that they will be covered by at least 3/4 inch thickness of grout at edges. Pull down anchor bolts to snugtight position prior to grouting. Do not remove wedges until grout has set.
7. In general, depth of grout to be 3/4 inch to 1-1/2 inches thick under bearing edges and pads of baseplates and equipment. Strike off at level 1/2 inch above bottoms of bearing edges or pads.
8. Thoroughly clean top of concrete foundations and pads prior to grouting. Construct board dam around top of foundation or pad to contain grout. Install 3/4 inch bevel strip around interior of dam to assure neat 45 degree slope at top edge of grout, when set. Block around wedges to allow removal of wedges after grout has set. Space between anchor bolts and sleeves must be open to allow grout to fill such space.
9. Wet concrete surface and pour grout in holes provided in baseplates to fill all voids under baseplates and bearing edges. Neatly and smoothly strike off grout flush with top of grout hole lips and top edges of bevel strips. Where no grout holes are provided, such as at some bearing pads, use minimum amount of water in grout to provide consistency suitable for dry packing. Bevel edges 3/4 inch with a trowel.
10. After grout has set, remove wedges, patch voids with grout and rub exposed surfaces of grout with abrasive stone to smooth dense finish. Edges of grout to be vertically flush with edges of foundations and pads.
11. Prior to grouting, accurately align power driven equipment comprised of two or more components not mounted on baseplates but interconnected with flexible couplings. After grouting has set and piping connections made, check alignment. If not in proper alignment at that time, realign prior to operation.
12. Accurately align baseplate-mounted power-driven equipment after baseplate has been grouted, grout has set and piping connections made. Dowel with taper pins but not until equipment has been test-operated sufficiently to confirm proper alignment. Furnish dowel pins required, complete with jack nuts.
13. Align couplings with precision dial indicator gages and other necessary measuring devices to accuracy of 0.002 inch. Equipment must be in proper alignment at operating temperatures.

### 3.13 CUTTING AND PATCHING

- A. Where sleeves, framing or forming have not been placed for proper installation of the work, or where necessary for other reasons, perform cutting operations only as authorized.

- B. Patch such openings in accordance with the applicable requirements specified under other divisions of these specifications by workers skilled in the trade involved.
- C. Neatly band holes cut in gratings. Where gratings are galvanized, coat band and abraded surfaces using two coats of Porter Paint Co. No. 285 U-Prime Universal Alkyd Primer, or approved equal.
- D. Holes cut in structural steel must be drilled or punched, not cut with torch.

### 3.14 PROTECTION

- A. Follow manufacturer's suggested procedure for protection of equipment which will be idle for an extended period of time prior to start-up.
- B. Protect piping and equipment at all times against entrance of dirt and moisture and injury to pipe joints or equipment surfaces during construction by means of caps, plugs, canvas or plastic covers.
- C. During shipment, and before and during erection, protect materials and equipment from weather damage. Keep materials and equipment off ground by means of wood blocks or skids. Take all necessary measures to prevent rusting or binding of internal parts of rotating equipment. Properly store all instruments and control components to prevent corrosion.

### 3.15 FIELD CONDITIONS

- A. The various trades involved in the project must properly coordinate their work to fit available space. If there is any question as to where system components should be located so that the work of other trades can be properly installed, meet and discuss such questions with the other trades involved, jointly prepare sketches or coordination drawings if necessary, and otherwise coordinate the work. Any work installed in such locations as to prevent other trades from installing their work with reasonable convenience must be relocated without increase in the contract price.
- B. Drawings indicate desired position of equipment and routing of ducts, piping and conduits. If field conditions are encountered which make arrangements indicated impractical or impossible, submit request for deviation in writing, with drawings if required to clarify request. Do not proceed until request is accepted and authorized in writing.

### 3.16 RESTORATION OF EXISTING FACILITIES

- A. Replace and restore to their original undamaged condition, all facilities of every description damaged or disturbed during progress of work. Such replacement or restoration applies to both surface and subsurface installations and materials. Match existing installations.

### 3.17 FUTURE WORK

- A. Install all work so as not to interfere with space provided for future construction and so as to facilitate the future installation and coordinate it with the work included under these specifications.

### 3.18 PRIME PAINTING

#### A. General:

1. Clean surfaces to remove all dirt, oil, grease, dust, scale and foreign matter before applying paint.
2. Items not to be prime painted:
  - a. Factory finished surfaces unless furnished as part of unitary assembly.
  - b. Stainless steel surfaces.
  - c. Plated surfaces.
  - d. Plastic piping.
  - e. Inside of pipes, conduits and electrical devices.
  - f. Wearing and machine finished surfaces.

#### B. Shop-fabricated or manufactured equipment and materials:

1. Prior to shipment to the job and unless factory finish is specified, clean and prime paint all ferrous surfaces, including black steel piping, with one coat of primer.
2. If prior painting is not part of manufacturer's standard procedure, prime paint surfaces as hereinafter specified for field-painted items.

#### C. Field prime painting:

1. Prior to installation, clean and prime paint job-fabricated ferrous surfaces, structural and/or supporting steel members and other parts which are subject to rust or corrosion, with one coat of primer.
2. Immediately after installation, thoroughly clean and reprime shop-coated and field-coated materials or equipment which show damage to prime coat or evidence of corrosion.

#### D. Finish painting:

1. Except as otherwise specified, field finish painting is included under Section 09900 of these specifications.

### 3.19 APPEARANCE

- #### A. Give special attention to the appearance of work exposed to view. In general, install materials and devices in accordance with the requirements specified hereinafter and as otherwise required to give a pleasing appearance.

- B. Where appropriate, install materials and devices parallel or perpendicular to the building lines.
- C. Where installation height is not indicated or where there is any question as to the appearance of the installation, locate devices as directed by the Construction Manager.

### 3.20 EQUIPMENT IDENTIFICATION

- A. Provide factory-installed permanent name tags for each item of mechanical equipment.
- B. Name tag to be riveted or otherwise securely attached to equipment in accessible location near manufacturer's nameplate.

### 3.21 PIPE IDENTIFICATION

- A. Identify all piping as hereinafter specified.
- B. Identify after insulation and painting have been completed as specified under other sections of these specifications. Apply identification at each valve, at each side of partitions or floors through which the pipes pass, near each branch connection, and elsewhere at intervals of not more than 20 feet. Identification to include directional flow arrows. Locate identification markers longitudinally with piping and so as to be easily visible.
- C. Identification markers to lap minimum 1 inch circumferentially around the pipe or pipe insulation, or to be secured with a 2 inch wide plastic tape band on each end of label. Install labels and banding tape on piping smooth and free of wrinkles.

### 3.22 UNDERGROUND PIPE MARKERS

- A. During backfilling of exterior underground piping, provide continuous underground line markers located directly over buried line at 6 to 8 inches below finished grade.

END OF SECTION

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SECTION 15250

INSULATION

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Applicable provisions of Section 15050 form a part of this Section.

1.2 DESCRIPTION OF WORK

- A. Furnish all labor, materials and equipment, and do all work necessary for the complete installation of insulation work as specified hereinafter.
- B. The following are not to be insulated:
  - 1. Flexible piping connections.
- C. Related Work Not Specified In This Section:
  - 1. Painting
  - 2. Identification

PART 2 - PRODUCTS

2.1 MATERIALS - GENERAL

- A. Where pipe insulation is specified hereafter to be sealed for a vaporproof installation, furnish a circumferential insert of foam glass pipe insulation, for installation at each pipe hanger, equivalent to thickness scheduled hereinafter, complete with vapor barrier jacket. Insert to be same length as the insulation protection shield. Vapor barrier jacket to overlap the adjoining insulation a minimum of 2 inches. Pipe hangers and insulation protection shields are specified in Section 15050 and are to be provided under Section 15942.

2.2 CLASS 1 SURFACES

- A. Service:
  - 1. All steel piping located in the SWRB valve house.
- B. Materials:
  - 1. Armstrong AP Armaflex, Rubatex R-180-FS, or approved equal, fire-retardant flexible foamed plastic insulation in one-piece molded sections, minimum 5.5 pounds per cubic foot density, 3/4 inch thick indoors.

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C. Factory-applied jacket:

1. None required.

2.3 CLASS 2 SURFACES

A. SERVICE:

1. Contaminated effluent piping, outdoors aboveground

B. MATERIALS:

1. Marville, Certain-Teed, Knauf or Owens-Corning Fiberglas, or approved equal, glass fiber insulation in one-piece molded sections, nominal 4 pounds per cubic foot density, 2 inches thick.
2. Factory-applied jacket:
  - a. All purpose jacket.

PART 3 - EXECUTION

3.1 GENERAL WORKMANSHIP

- A. Install insulation in strict accordance with manufacturer's recommendations and these specifications. In cases of conflict, these project specifications govern.
- B. Apply insulation only after pipes have been tested and proved tight as specified, are thoroughly clean and dry, and show no evidence of leakage. Notify the Construction Manager immediately if leaks are found.
- C. Apply insulation to surfaces to be heat traced only after tracing has been completed and tested. Insulation applied over traced piping to be sized to accommodate tracing. Do not groove insulation.
- D. Butt adjoining sections of all insulation firmly together. Cut, miter and shape insulation to insure close fit, eliminating cracks and voids.
- E. Where insulation is applied on ducts, pipes which are against columns, walls or other equipment, without adequate space for insulation, provide means for finishing off insulation in neat, workmanlike and secure manner.
- F. Where insulation on pipes extends through sleeves in walls, provide an 18 gage galvanized steel insulation protection sleeve. Wall sleeves are provided under other sections of Division 15 of these specifications.
- G. Pipe insulation jackets to extend through sleeves in exterior walls aboveground.
- H. Do not use staples or other penetrating devices on any insulation, unless otherwise specified.

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- I. Insulation jackets installed outdoors to be completely weatherproof.
- J. Spread tarpaulins or provide temporary cover over equipment, uninsulated pipes and ducts, handrails, and similar construction as protection from dirt and rubbish caused by installation of insulation. Remove all rubbish as job progresses.
- K. Repair any existing insulation damaged as result of work under this section with materials to match existing materials, or as directed.
- L. Repair or replace, as directed, any existing insulation damaged or removed during any tie-in connections, removal or relocation of any existing equipment, or pipe. Use materials to match existing materials, or as directed.

### 3.2 INSTALLATION OF CLASS 1 SURFACES

- A. Seal insulation for a vaporproof installation.
- B. Seal longitudinal and circumferential joints of insulation with Armstrong 520, Rubatex R-373, or approved equal, adhesive.
- C. Insulate flanges, fittings, valves, and other miscellaneous piping specialties with fabricated insulation blocks and shapes of material and thickness specified for adjacent insulation. Seal all joints with Armstrong 520, Rubatex R-373, or approved equal, adhesive.
- D. Field finish for indoor insulation to be as follows:
  - 1. No additional finish required.
- E. Field finish for outdoor insulation to be as follows:
  - 1. Apply two coats of Armstrong "Armaflex finish", or approved equal.

### 3.3 INSTALLATION OF CLASS 2 SURFACES

- A. Seal insulation for a vaporproof installation.
- B. Seal longitudinal seams of jacket with Foster 85-75, Childers CP-82, or approved equal, vapor barrier adhesive. Seal circumferential joints with 3 inch wide factory - furnished vapor barrier butt sealing strips adhered with the same vapor barrier adhesive.
- C. Seal ends of pipe insulation at flanges and valves and at intervals of not more than 21 feet with Foster 30-35, Childers CP-30, or approved equal, vapor barrier coating.
- D. At each insulation protection shield location, provide vapor seal using Foster 95-49, Childers CP-76, or approved equal, vapor barrier sealant.
- E. Insulate flanges, fittings, valves, strainers and other miscellaneous piping specialties with blanket insulation or fabricated insulation blocks and shapes of material and thickness specified for adjacent insulation. Wire or tape insulation in place.

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F. Field finish to be as follows:

1. All straight runs of insulation to have an outer weatherproof jacket of 16 Mil stucco embossed aluminum with self-locking longitudinal seam, butt type circumferential joints, and butt joint sealing strips having an integral weatherproof mastic.
2. Place longitudinal seam of weatherproof jacket at either 4 or 8 o'clock, approximately, position to shed water. Secure in place with stainless steel bands 18 inches on center.
3. Over flanges, fittings, valves, strainers and other miscellaneous piping specialties, apply 0.016 inch thick aluminum jacket with weatherproof banding strips at joints. Elbows to be factory-fabricated two-piece preshaped or three-piece miter. Seal all joints with Foster 95-44, Childers CP-76, or approved equal, weatherproof sealant.

END OF SECTION

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SECTION 15300

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FIRE PROTECTION SYSTEM

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Applicable provisions of Sections 15050 and 15990 form a part of this section.

1.2 DESCRIPTION OF WORK

A. Work Specified Under This Section:

1. Furnish all labor, materials and equipment, and do all work necessary for the complete design and installation of fire protection work specified hereinafter and as shown on the drawings. Design of systems to be in accordance with requirements of standards referred to herein.
2. Personnel installing Fire Protection Systems to be certified by The State of Ohio or supervised by a certified sprinkler company employee. Certification number and date to be submitted to FEMP Fire and Safety Section prior to the start of work. Certification to appear on all materials submitted for review and approval.
3. In general, work under this section includes:
  - a. New wet type sprinkler system for SWRB Valve House.
  - b. Alarm devices.
  - c. Main piping, including connections to existing piping.
  - d. Post indicator valve.
  - e. Fire hydrants.
  - f. Excavation and backfilling required.
  - g. Prime painting.
  - h. Pipe identification.
  - i. Underground Pipe Markers.
  - j. Flushing and cleaning
  - k. Tests and adjustments

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4. Install Operating Contractor furnished equipment described hereinafter in conformance with any instructions included herein and the applicable requirements of Section 15050. Operating Contractor furnished equipment includes:

- a. Water Flow Switch.
- b. Riser shutoff valve supervisory switch.

B. Related Work Not Specified Under This Section:

1. Electric wiring, except as otherwise indicated.
2. Concrete work, except thrust blocks or as otherwise specified.
3. Finish painting, except as specified.
4. Fire extinguishers.

### 1.3 CODES AND STANDARDS

- A. All work to meet approval of the authorities having jurisdiction and the Operating Contractor's Fire and Safety Section.
- B. All work to conform to requirements of National Fire Protection Association Standards No. 13 and 24.
- C. Where the requirements of this section are more stringent than the requirements of the referenced standards, the requirements of this section govern.

### 1.4 DESCRIPTION OF SYSTEM

A. SWRB Valve House:

1. A new Underground fire main to be extended to serve a new fire hydrant and a 4 inch branch main, with post indicator valve, to serve the building riser. Riser to include alarm check valve and water flow switch.
2. The building to be protected by a wet type sprinkler system, with piping sized, and sprinklers spaced for ordinary hazard, 130 square feet per sprinkler.

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1.5 SUBMITTALS

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- A. As soon as practicable after award of contract, and before proceeding with any work, submit four sets of preliminary drawings showing the location of all mains, branches, valves and specialties, the proposed sprinkler size and arrangements, test pipe and valves, drain connections and other pertinent information.
- B. In addition, submit to the Insurance Underwriter complete layout and working drawings and calculations for review, and secure final approval before proceeding further. Furnish two complete sets of all approved drawings and calculations. Drawings which are "approved as noted" will not be accepted.
- C. After completion of construction and all required acceptance test, furnish two complete sets of "As Built" drawings with pertinent information to FEMP Fire and Safety Section showing all approved field modifications.

PART 2 - PRODUCTS

2.1 SPRINKLERS

- A. Sprinklers to be soldered link or glass bulb type.
- B. Sprinkler types and finish to be as follows:

<u>Location</u>	<u>Type</u>	<u>Finish</u>	<u>Temperature Rating</u>
Exposed areas	Pendent	Brass	165F

- C. Use higher temperature ratings in zones near heat producing apparatus or piping as required by NFPA Standard No. 13. Determine temperature rating for each sprinkler head at the job.

2.2 SPRINKLER CABINET

- A. Provide steel cabinet containing sprinkler wrenches and sprinklers of assorted types and ratings in proportion to their usage in installation. Quantity of sprinklers to be in accordance with NFPA Standard No. 13. Cabinet to be given to the Operating Contractor's Fire and Safety Section.

2.3 ALARM DEVICES

- A. Provide the following at the riser:
  - 1. Alarm check valve (ACV), of size shown on drawings, with retard chamber and water motor alarm.

2.4 FIRE HYDRANTS

- A. Waterous "Pacer" 100, or equivalent M & H, Mueller, American-Darling, Kennedy, or approved equal, flanged inlet pipe connection, 5-1/4 inch valve opening two 2-1/2 inch hose

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connections, and one pumper connection. Hose threads to match those used by FMPC fire department. Provide barrel extension, if required, sized as required for depth of bury. Provide minimum of two hydrant wrenches.

- B. Each hydrant to be complete with companion valve on hydrant inlet, Waterous Series 500, mechanical joint inlet, flanged outlet, 175 pound WWP, cast-iron body, bronze mounted, non-rising stem, 2 inch square operating nut, rubber coated cast-iron wedge, epoxy coated inside and out, AWWA C 509, with three-piece valve box, or equivalent M & H, Stockham, Mueller, Kennedy, or approved equal. Provide two tee-handled operating wrenches of lengths suitable for valve depth.

## 2.5 POST INDICATOR VALVES

- A. Waterous Series 500, or equivalent M & H, Stockham, Mueller, Kennedy, or approved equal, mechanical joint ends, 175 pound WWP, cast-iron body, bronze mounted, non-rising stem, 2 inch square operating nut, rubber coated cast-iron wedge, epoxy coated inside and out, AWWA 509. Provide Waterous No. A-240 indicator post with target to show if valve is open or shut. Provide post indicator extension, if required, length as required for depth of bury. Provide minimum of two wrench handles.

## 2.6 PIPING SYSTEM MATERIALS

### A. General:

1. Provide piping system materials for services as indicated in schedules hereinafter.
2. Refer to other articles in this section for special valve requirements and exceptions to valve types specified in the schedules.

### B. Sprinkler, aboveground:

1. Pipe: Black steel, schedule 40, ASTM A53
2. Joints: Screwed or flanged to suit conditions. Joints may be shop welded using butt welding end type fittings
3. Fittings: Cast-iron, screwed or flanged, 125 pound. Contractor may, at his option, use Gustin-Bacon No. 120, Victaulic Style 005, Grinnel "Gruvlok" Figure 7401, or approved equal, UL-listed, groove type couplings with EPDM gaskets
4. Valves: Gate valves - flanged ends, 175 pound WWP, cast-iron body, bronze mounted, cast-iron wedge, OS&Y, Waterous No. A-266, or equivalent M & H, Stockham, Mueller, Kennedy, American-Darling, or approved equal.

Globe valves - Screwed ends, 200 pound, bronze body, union bonnet, rising stem, renewable disc and seat, Powell Figure 102, Stockham Figure B-61, Nibco Figure T-276-AP, or approved equal.

Check valves - Flanged ends, 175 pound WWP, cast-iron body, bronze mounted, bolted flanged cap, horizontal swing, bronze disc, waterous series

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6800, or equivalent M & H, Stockham, Mueller, Kennedy, American-Darling, or approved equal.

5. Contractor may, at his option, use schedule 10 black steel pipe, ASTM A 135. Piping to be joined by shop welding, or piping to be roll grooved and connected with Gustin-Bacon No. 120, Victaulic Style 005, Grinnel "Gruviok" Figure 7401, or approved equal, UL listed, fittings and couplings with EPDM gaskets.

C. Water supply, underground:

1. Pipe: Ductile iron, ANSI A21.51, thickness Class 52, 350 PSIG rated, cement lined, ANSI A21.4
2. Joints: Mechanical joint or push-on, in conformance with ANSI A21.11, including notes on method of installation. Make joints as directed by manufacturer
3. Fittings: Mechanical joint, ANSI A21.10, to match pipe. Where pipe enters building, use special fitting having standard flange on one end
4. Gaskets: Neoprene, ANSI A21.11

2.7 PRESSURE INDICATOR (GAGE.)

- A. Ashcroft No. 1220A, or approved equal 4-1/2 inch dial, phenolic case, or equivalent Palmer, Marshalltown, Weksler or Terice. Locate so that dial can be easily read.

PART 3 - EXECUTION

3.1 SPRINKLERS

- A. Provide sprinkler guards for sprinklers subject to mechanical injury.
- B. Sprinkler cabinet for spare sprinklers to be turned over to the Operating Contractor's Fire and Safety Section.

3.2 SETTING OF FIRE HYDRANTS

- A. Install hydrants where shown, at such elevations that connecting pipes will have minimum cover of 72 inches and distance from bottom of hose connections to grade will not be less than 18 inches. Provide solid concrete block beneath base of each hydrant. For drainage of each hydrant, place not less than 7 cubic feet of clean, well graded 3/4 inch gravel from bottom of hydrant to at least 6 inches above waste opening in hydrant and around base for distance of 1 foot. Secure hydrants by anchoring to tees in main with bridle rods and rod collars. Bridle rods and rod collars to be 3/4 inch stock painted with acid-resistant paint. Clean all foreign material from interior of hydrants.

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### MAIN DRAIN CONNECTION

- A. On riser entering building, provide main drain connection, sized in accordance with NFPA Standard No. 13, complete with globe valve. At main drain connections, provide pressure gage connected to riser. Extend main drain piping to threaded connection into drain or through wall as shown.
- B. Pitch all piping in accordance with NFPA Standard No. 13. Provide satisfactory means for draining all low points.

### 3.4 TEST PIPES

- A. For system:
  - 1. Provide 1 inch test pipe at highest and most remote point from the riser in each riser system. Unless otherwise indicated, extend discharge through sight glass to outside building. Terminate in 1/2 inch bore brass outlet at point where it can be easily seen. Install control valve on test pipe within easy reach of floor.
- B. For water supply:
  - 1. The main drain connection specified hereinbefore is to serve as the water supply test pipes required by NFPA Standard No. 13.

### 3.5 FLUSHING AND CLEANING

- A. Flush all underground piping with water at the flow rate designated in NFPA Standard No. 24. Flush indoor main piping in accordance with the requirements of NFPA Standard No. 13. Continue flushing until discharge water shows no discoloration for a minimum of 3 minutes. Drain at low points.

### 3.6 IDENTIFICATION OF PIPING

- A. Identify all piping as specified under Section 15050. In addition to other identification specified, all above ground sprinkler piping to be painted red.
- B. Underground Pipe Markers: Markers for underground piping to be as specified under Section 15050.

### 3.7 TESTS AND ADJUSTMENTS

- A. All tests and adjustments to be as specified under Section 15990. After tests are completed, immediately prepare systems for service.

END OF SECTION

SECTION 15500

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HEATING AND VENTILATING

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Applicable provisions of Sections 15050 and 15990 form a part of this section.
- B. All electrical work to be in accordance with the National Electrical Code, applicable NEMA Standards and applicable requirements of Division 16.
- C. Motors and electrical components to conform to the requirements of the Equipment Coordination Schedule included in Appendix A.

1.2 DESCRIPTION OF WORK

A. Work specified under this Section:

- 1. Furnish all labor, materials and equipment, and do all work necessary for the complete installation of Heating and Ventilating systems specified hereinafter and as shown on the drawings.
- 2. In general, work under this Section includes:
  - a. Heating equipment.
  - b. Ventilating equipment.
  - c. Prime painting.
  - d. Equipment identification.
  - e. Tests and adjustments.

B. Related Work Not Specified Under This Section:

- 1. Electrical wiring, except factory-prewired equipment and devices as specified hereinafter.
- 2. Piping and associated equipment.
- 3. Finish painting, except as specified.

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PART 2 - PRODUCTS

2.1 GENERAL

- A. Provide Heating and Ventilating equipment of type, size and capacity as scheduled and as specified hereinafter. Heating and Ventilating equipment of the same type to be by the same Manufacturer.
- B. Motors for the equipment specified herein to be in accordance with the applicable requirements of Section 15050.

2.2 POWER WALL VENTILATOR

- A. Cook Type SPD as scheduled, or equivalent Aerovent, Ilg, or approved equal, propeller wall ventilators, with steel housing. Fan to have 1/2 inch mesh inlet screen and manufacturer's standard direct drive motor.
- B. Provide gravity backdraft dampers, manufacturer's standard, having parallel action type aluminum blades and common linkage.

Schedule

<u>Fan Designation</u>	<u>18-X100-FAN</u>
Model and size	18 SP 10D
Capacity, CFM	1,500
Static pressure, inches WG	0.25

2.3 UNIT HEATERS, ELECTRIC

- A. Brasch as scheduled, or equivalent Chromalox, or approved equal, propeller fan type, UL listed, horizontal discharge, with two-stage built-in thermostat, positive "Off" disconnect switch, magnetic control contactor, two step control, ceiling mount swivel bracket, fan guard and manufacturer's standard direct-connected motor. Provide with adjustable horizontal louvers. Materials and finishes to be manufacturer's standard.

Schedule

<u>Unit Designation</u>	<u>Model No.</u>	<u>Rating, KW</u>	<u>Capacity, BTUH</u>	<u>Ent. Air Temp. F.</u>	<u>Airflow, CFM</u>	<u>Motor Speed, RPM</u>
18-X100-HTR	2.5-2081	2.5	8,550	55	350	1,550
18-X101-HTR	2.5-2081	2.5	8,550	55	350	1,550

2.4 AUTOMATIC DAMPERS AND DAMPER OPERATORS

- A. Automatic dampers:

- 1. Automatic dampers to be 16 gage or double formed 22 gage, steel, to open against stops, and close against urethane foam seals. Blade side edges to seal off against

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spring stainless steel seals. Damper to be suitable for operation from minus 40F to 200F. Provide 13 gage galvanized steel damper frames equipped with nylon or oil-impregnated bronze bearings. Damper leakage not to exceed 1 percent of design flow at design close-off pressure. Dampers to be parallel blade type.

B. Damper operators:

1. Two-position, line voltage, spring return, with internal auxiliary switch, fixed 160 degree stroke and 60 second timing.

**PART 3 - EXECUTION**

**3.1 GENERAL**

- A. Heating and Ventilating equipment to be installed where indicated, in accordance with the applicable requirements of Section 15050, and in accordance with the Manufacturer's installation instructions.

**3.2 TESTS AND ADJUSTMENTS**

- A. Tests and adjustments to be in accordance with applicable requirements of Section 15990.

**END OF SECTION**

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SECTION 15942

PIPING AND ASSOCIATED EQUIPMENT

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Applicable provisions of Sections 15050 and 15990 form a part of this section.
- B. Applicable provisions of Appendices A, B, C, D, E and F form a part of this section.

1.2 DESCRIPTION OF WORK

A. Section Includes:

- 1. Furnish all labor, materials, installation and equipment and tools, and do all work necessary for the complete installation of piping and associated equipment as specified herein and as shown on the drawings.
- 2. In general, work under this Section includes:
  - a. Force main piping.
  - b. Outfall Line.
  - c. Installation of in-line mounted instrumentation item as indicated in Appendix D.
  - e. Miscellaneous materials for support and anchorage of piping and equipment.
  - d. Receive from the Operating Contractor's warehousing area, inspect, transport to installation location and install Operating Contractor-furnished piping materials.
  - f. Concrete Equipment Pads.
  - g. Modification work as indicated.
  - h. Pumps.
  - i. Manholes.
  - j. Road crossing.
  - k. Prime Painting.
  - l. Cleaning and flushing.
  - m. Pipe identification.
  - n. Underground pipe markers.

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o. Tests and adjustments.

B. Related Work Specified Under Other Sections:

1. Heating and Ventilating Equipment.
2. Electrical wiring, except factory-prewired equipment.
3. Insulation
4. Instrumentation, except installation of in-line mounted items
5. Concrete work, except as indicated.
6. Electric heat tracing.
7. Finish painting, except as specified

C. Work Not Included:

1. Recovery well field, well field piping, pumphouse and aeration system.
2. Discharge piping from Manhole 182B to the Great Miami River.
3. Culverts and associated headwalls.

1.3 SHOP DRAWINGS AND SUBMITTALS

- A. Prior to commencing any work, submit for review and coordination a schedule and description of methods and materials proposed for effecting the installation of all piping and associated equipment. The Construction Manger reserves the right to review and accept the Subcontractor's proposed sequence and method for the installation of piping and associated equipment as the Construction Manger deems necessary.
- B. Refer to Section 01100 for additional information and requirements regarding submittals.

1.4 COORDINATION

- A. Coordinate the work under this section with the electric heat tracing work being provided under Division 16.
- B. Particular attention is called to the requirement for coordination of piping and associated equipment with the installation of electrical conduit systems.

1.5 JOB CONDITIONS

- A. Verify all dimensions shown on the drawings in the field. Report all discrepancies in accordance with the requirements of Section 15050.

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1.6 PROTECTION OF WORK

- A. Protect piping from all damage including weld spatter during construction.
- B. On machine-finished surfaces, polished surfaces, or other bare metal surfaces which are not to be painted, such as machinery shafts and couplings, provided temporary protection during storage and construction by coating with an oily type rust preventive compound.

1.7 ELECTRICAL REQUIREMENTS

- A. All electrical work to be in accordance with the National Electric Code, applicable NEMA Standards, applicable requirements of Division 16, and conform to the requirements of the Equipment Coordination Schedule included in Appendix A.

PART 2 - PRODUCTS

2.1 OPERATING CONTRACTOR-FURNISHED MATERIALS

- A. The Operating Contractor will furnish all piping and fitting for underground treated water (TWX-1), groundwater (GW1) and contaminated effluent (CE-1), and underground outfall sewer (ST1). Specifications for Operating Contractor-furnished piping materials is included in Appendix F. Receive such materials from the Operating Contractor, examine and immediately report in writing to the Construction Manager, any shortages, discrepancies or damage. Assume full responsibility for inspection, proper care, transportation, protection, handling and storage materials, and for delivery of materials to temporary or intermediate storage facilities, if necessary.
  - 1. The Construction Manager will indicate the name of the pipe and fitting manufacturer prior to the bid due date.
- B. After all material is received in good condition, accept full responsibility for any damage or shortages, and for proper accounting of material until final acceptance of the work.
- C. Replace all Operating Contractor-furnished material which is lost or damaged while in the custody of the Subcontractor. Replaced materials to be type and quality equal to the original, and acceptable to the Operating Contractor.

2.2 SUBCONTRACTOR-FURNISHED MATERIALS

- A. General
  - 1. Provide all piping and equipment required for the installation of piping and associated equipment as shown on the drawings and described in the equipment specifications included in Appendix B, the piping material specifications included in Appendix C, and as hereafter specified.
  - 2. Provide valves strainers and miscellaneous piping specialties of manufacturer's numbers designated in the Piping Material Specifications included in Appendix C, or approved equal.

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- B. Automatic Air Vents:
1. Spirax Sarco type 13W, Hoffman No. 78, or approved equal, with stainless steel float.
- C. Post Indicator Valve:
1. Pratt "Groundhog", or approved equal, UL-Listed, flanged ends, 150 pound WWP, cast-iron body, cast-iron disc with NI-chrome edge, type 304 stainless steel shaft, rubber seat, 2 inch square operating nut, AWWA C 504, Class 150 B, and with Style G adjustable indicator post to show if valve is open or shut. Provide post indicator extension as required for depth of bury. Provide with locking type detachable operating wrench.
- D. Underground Gate Valve:
1. Waterous Series 500, or equivalent M & H, Stockham, Mueller, Kennedy, American-Darling, or approved equal, with flanged ends, 175 pound WWP, cast-iron body, bronze mounted, non-rising stem, 2 inch square operating nut, rubber coated cast-iron wedge, epoxy coated inside and out, AWWA C 509. Provide each valve with two-piece screw type valve box having locking cover. Provide two tee-handled operating wrenches of lengths suitable for depth of bury.
- E. Vacuum Breakers:
1. Watts No. N36, or approved equal, set to open at 1/2 inch vacuum.
- F. Pressure Relief Valve:
1. Watts No. 116 with No. PV20 Pilot Valve, or equivalent Cla-val, or approved equal, pressure relief and backpressure valve.
- G. Miscellaneous Installation Materials:
1. Provide all installation materials as necessary including but not limited to grout, shims, bolts, nuts, fasteners, miscellaneous plates, angles and shapes and all other material required for a complete installation of equipment in accordance with applicable provisions of Section 15050 and applicable Manufacturer's printed instructions.

## 2.2 MANHOLES

- A. Construct of poured concrete as detailed on the drawings, of sizes, depths and at locations indicated. Where steps are indicated, provide Neenah No. R-1982-J, or approved equal, ductile iron manhole steps, 12 inches on center. Stub-ends of polyethylene pipe to be cast in manhole wall in accordance with detail on drawings.
- B. Where precast reinforced concrete sections are indicated, precast to conform to ASTM C 478 with joints conforming to ASTM C 443.
- C. Provide Neenah, or approved equal, cast-iron manhole covers and frames as indicated on the drawings.

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- D. Set frames on two courses of hard burned brick or concrete rings as indicated.

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### PART 3 - EXECUTION

#### 3.1 INSTALLATION OF PIPING SYSTEMS

##### A. General:

1. Material designations on drawings indicate piping material to be provided for particular services. Subcontractor-furnished piping materials and appurtenances to be in accordance with piping material specifications included in Appendix C.
2. Any line to be installed under this section not having a material code shown on drawings to be of materials designated for similar services.
3. Hangers and supports for piping to be as specified in Section 15050.

##### B. Polyethylene Piping System:

1. Polyethylene pipe and fittings to be heat joined using the butt fusion method as specified herein in accordance with applicable requirements of ASTM D 2675, and the manufacturer's recommendations.
2. Work under this section to include the following:
  - a. Provide a qualified fusion instructor of the polyethylene pipe and fitting manufacturer to train a maximum of two designated fusion operators from the Subcontractor's personnel. Fusions to only be performed by operators who have been approved and trained by the manufacturer.
  - b. Provide fusion equipment that is in good working order. Fusion equipment to have suitable quick release, no contamination.
  - c. Provide a qualified representative of the piping and fitting manufacturer to visually inspect and mark each fusion bead prior to installation of the pipe and fittings.
  - d. For Operating Contractor-furnished material, the training and inspection requirements of the manufacturer are to be performed by the same manufacturer from which the Operating Contractor purchases the piping and fittings.

##### C. In-line mounted Instruments:

1. Certain items of instrumentation, as indicated in Appendix D, will be furnished under Section 15945 for in-line installation in the piping systems under this Section.
2. Do not install in-line devices which might be damaged by debris during pipe flushing operations. Install after piping has been flushed and tested in accordance with Section 15990.

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0329 INSTALLATION OF EQUIPMENT

- A. Provide all supports, braces and anchors necessary for the correct installation of all equipment as required for satisfactory operation of the systems. Certified drawings or actual field-mounted data are to be used for determining all dimensions. Do all necessary coordination for proper execution of work.
- B. Provide temporary bracing required while placing equipment, and upon setting equipment, reinstall all members which were removed. Properly torque all bolted connections in accordance with requirements specified in Section 15050.
- C. Provide concrete foundations and pads as required for equipment.
- D. Determine exact extent of field assembly required for all equipment from examination of manufacturer's printed instructions and certified shop drawings.
- E. Mount and align equipment in accordance with manufacturer's printed recommendations and in accordance with procedures described hereinafter and in Section 15050. In cases of conflict, manufacturer's printed recommendations govern.
- F. Where structural or miscellaneous steel is not drilled in shop, drill in field as directed.
- G. Confer with Owner's Representative if in doubt about attaching rigging to building structure.
- H. If detail is not indicated on drawings, anchor all items to concrete or steel in accordance with Section 15050 and any specific requirements specified hereinafter.
- I. Level and grout in accordance with Section 15050.
- J. Lubricate equipment prior to operation. Lubrication to be in accordance with manufacturer's recommendations, or, if lubrication instructions are not available, as directed. Furnish all required lubricants.
- K. Provide coupling guards and safety guards over all exposed rotating parts, including all guarding required to comply with Federal Occupational Safety and Health Act Standards. Guards shall not interfere with normal lubrication operations nor be required to be removed for normal maintenance operation.
- L. Uncouple all drive motors and check direction of rotation. Insure start-stop buttons are operative.
- M. Turn all motor-driven equipment manually before applying power. Notify Construction Manager of any binding, rubbing, squeaking, wobble, or suspicious conditions.

3.3 ROAD CROSSINGS

- A. Provide all equipment, labor, materials and do all work necessary to complete the force main crossings under Willey Road and under State Route 128, as specified in Section 02300.

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- B. Install casings under the roads to the lines and grades indicated on the drawings. Provide sheeting, shoring and bracing as required. Install carrier piping in casings using Maloney Model 59 Steel Band casing insulators, or approved equal. Seal ends of the annular space between the casings and carrier pipe with Maloney Multiflex molded end seals, or approved equal.

### 3.4 PIPING CONNECTIONS

- A. Level, align and wedge in place all equipment having piping connections prior to initial fitting and alignment of connecting piping. Prior to final connection of piping, grout or bolt all equipment to foundation or support.

### 3.4 ELECTRICAL CONNECTIONS

- A. Motors and other equipment requiring electrical connections will have such wiring and connections made as part of the work under Division 16 of these specifications.
- B. Installation to be such that during calibration, maintenance and normal operation, no person shall be exposed to voltages of 50 volts or more.

### 3.5 ELECTRIC TRACING OF EQUIPMENT

- A. Coordinate work under this section with the electric heat tracing work being performed under Division 16.

### 3.6 CLEANING AND FLUSHING PIPING

- A. After all piping and equipment have been installed and pressure tested as specified in Section 15990, and before any operating tests, clean and flush each system as described herein. Provide all necessary temporary equipment required for cleaning and flushing including pumps, strainers, valves, pipe, fittings, drains and hoses.
- B. For water piping systems, flush with clean water. In general, use sufficient water to produce a minimum water velocity of 2.5 feet per second through piping being flushed. Continue flushing until discharged water shows no discolorations. Drain at low points. Leave piping drained.
- C. Drain and clean dirt pockets.
- D. Remove strainer screens, clean, and replace.
- E. Clean all equipment installed under this Section as detailed. Where appropriate, flush with water and drain.

### 3.7 IDENTIFICATION OF PIPING

- A. Identify all piping as specified under Section 15050.

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3.8 UNDERGROUND PIPE MARKERS

- A. Markers for underground piping to be as specified under Section 15050.

3.9 TESTS AND ADJUSTMENTS

- A. All tests and adjustments to be as specified under Section 15990.

END OF SECTION

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SECTION 15945

INSTRUMENTATION

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Applicable provisions of Sections 15050 and 15990 form a part of this section.
- B. Applicable provisions of Appendices A, D and E form a part of this section.

1.2 DESCRIPTION OF WORK

A. Work Specified Under This Section:

- 1. Furnish all labor, materials, installation equipment and tools, and do all work necessary for the complete installation of instrumentation systems as specified and as shown on the drawings.
- 2. In general, work under this Section includes:
  - a. Providing instruments specified in Appendix D.
  - b. Providing control panel.
  - c. Concrete pad for control panel.
  - d. Instrument calibration.
  - e. Prime painting.

B. Related Work Not Specified Under This section:

- 1. Piping and associated equipment.
- 2. Installation of in-line pipeline installed instruments and devices.
- 3. Electrical heat tracing.
- 4. Insulation.
- 5. Finish painting, except as indicated.
- 6. Heating and Ventilating temperature controls.

1.3 CODES AND STANDARDS

- A. In addition to compliance with laws and ordinances, equipment, materials, and work must conform to applicable provisions of the following standards and codes:

UGS

1. American National Standards Institute (ANSI).
2. American Society of Testing and Materials (ASTM).
3. Institute of Electrical and Electronic Engineers (IEEE).
4. Instrument Society of America (ISA).
5. Insulated Cable Engineers Association (ICEA).
6. National Electrical Code (NEC).
7. National Electrical Manufacturers Association (NEMA).
8. National Fire Protection Association (NFPA).
9. Underwriters Laboratories Inc. (UL).

#### 1.4 SUBMITTALS

- A. Refer to Section 01100 for information requirements regarding submittals.

#### 1.5 FIELD SUPERVISION

- A. An experienced field instrument supervisor is to be assigned to the job during all phases of construction.
- B. Supervision of instrument fieldwork is not to be considered adequate if turned over to a supervisor of electrical, pipe fitting, or other trade group.
- C. Provide the necessary manpower to coordinate instrument activities with other trades to meet project schedule.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. Raceway systems and wiring:
  1. Conduit, cable trays, wireways, wire, cable, busways, and appurtenances to be in accordance with Division 16.

#### 2.2 TAGGING

- A. Tag instrument components with a screwed-on stainless steel tag bearing the item number and service and any other information as directed by Construction Manager. Tag to be screwed, riveted, or otherwise securely attached to equipment.

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### PART 3 - EXECUTION

#### 3.1 INSTRUMENT MATERIALS

- A. Provide all control panels and instrument items required for the installation of instrumentation work as shown on the drawings and instrument specifications included in Appendix D.
- B. Maintain a current inventory of all instrumentation items to insure that specific instruments are available on the jobsite as required.
- C. Keep storage area neat, dry and weathertight.
- D. Take all reasonable care in storage and handling of the instrumentation items to insure that they remain in new condition.
- E. Cover for protection against weather and physical damage, any instrumentation item which may be outside storage structure prior to installation.
- F. Replace with new instrument item any devices that are stolen or damaged after being properly received and prior to final acceptance of the installation.

#### 3.2 INSTRUMENT INSTALLATION

##### A. General:

- 1. Install instrumentation in strict accordance with manufacturer's recommendations and in accordance with procedures described hereinafter. In cases of conflict, manufacturer's recommendations govern.
- 2. Locate instruments in the vicinity of the sensing point and in accordance with the following:
  - a. Provide sufficient free space or access for maintenance of instrument or operating unit.
  - b. Do not interfere or obstruct access to hand valves.
  - c. Leave a minimum 3 foot aisle in front of instruments.
  - d. Locate instruments for visibility from operating level.
- 3. Do not locate instruments where maintenance requires the use of a ladder unless specified or location is approved by the Construction Manager prior to installation.
- 4. Locate instruments within radius of 5 feet of position shown on drawings.
- 5. Group instruments together on a common support where possible, locate between 3 to 5 foot elevation above floor level, and position line mounted indicating and/or pad mounted recording devices near eye level.

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6. Locate on equipment connections or pipe connections those devices which can be adequately supported, are to remain accessible for maintenance, and will be unaffected by the conditions at the connection.
7. Mount small remote devices including pressure gages, and pressure switches, on sheet metal panels stiffened with metal angle.
8. On instruments having vent requirements provide bugproof vent.

**B. Flow instrument:**

1. Meter sensing lines to be sloped downward to instrument for liquid service, and upward for gas measurements.
2. For orifice plate installation in vertical pipe, bend or align tubing from lower tap upward to be level with upper tap before routing to instrument.
3. For magnetic flow transmitters, provide a metal grounding ring between both mounting flanges if installation is in electrically nonconductive or internally lined pipe. Weld grounding lug to pipe with lap joint flanges. For welded flanges, drill and tap edge of flange for 1/4 inch grounding screw.
4. Locate orifice flanges in a straight pipe section with minimum ten pipe diameters upstream and five pipe diameters downstream.

**C. Pressure instruments:**

1. Slope each sensing line upward to instrument for gas and noncondensable vapor and downward to instrument for liquid and steam service.

**D. Temperature instruments:**

1. Protect excess capillary tubing by loosely coiling a minimum of 1 foot diameter and fastening to a supporting plate or by supporting by metal tape.
2. Protect capillary tubing during construction from crushing, twisting, or other damage.

**E. Level instruments:**

1. Install gage glasses next to level instruments so that the level indication is visible when calibrating the level instrument.
2. Install gage glasses as close to the connections as possible and with the indication able to be seen at the operating level.
3. If float type level instruments are installed using a stilling well, provide sufficient holes in its wall to prevent a false level indication due to back pressure buildup inside the well.
4. When installing level bubbler tubes with clips on walls or sides of vessels, provide clips to allow replacement of the tube without damaging clips.

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F. Control valves:

1. When installing screwed control valves in horizontal lines with actuators in other than a vertical position, provide support rods to prevent the valve from rotating.
2. Wherever possible, install valves with actuators in vertical position, but never in a position below the horizontal, unless otherwise specified or indicated.

3.3 INSTRUMENT MOUNTING

A. Wall mounting:

1. Support on a 2 inch vertical section of pipe supported from a horizontal pipe or bar with a suitable steel baseplate, welded to the building steel, welded to nonsupporting steel members, or anchored to a masonry wall with expansion bolts.
2. Support on a subpanel of metal plate and metal angle with brackets welded to building steel or anchored to masonry walls with expansion bolts.

B. Floor mounting:

1. Support on a 2 inch vertical pipe welded to a baseplate or screwed to a floor flange. Weld directly to structural member rather than floor plate or grating, or bolt to a pad welded to structural member.

C. Pipe mounting:

1. Support on a pipe saddle or pipe clamp mounted on the pipe with 2 inch length of pipe to mount the instrument. Do not use this method if support pipe exceeds the vibration or temperature limits of the instrument.

3.4 INSTRUMENTATION ELECTRICAL CONNECTIONS

- A. All electrical work to be in accordance with the National Electrical Code, applicable NEMA Standards and applicable requirements of Division 16.

3.5 CALIBRATION AND TESTING

A. General:

1. Calibration instruments used for tests are to be maintained under a documented calibration program as specified in Section 01100.
2. Devices which are factory calibrated need not be recalibrated if individually acceptable to the Construction Manager.
3. All other devices to be field calibrated.
4. Subcontractor to furnish all tools and equipment required for calibration.

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5. Maintain a complete calibration report on each instrument on forms approved by Construction Manager.
6. The Construction Manager reserves the right to witness all calibrations and have any instruments aligned, calibrated or recalibrated to give an accurate, operable control system.

**B. Function Check:**

1. Make a final check of all controls when installation is essentially complete. Check every device to insure that all devices function as required and are correctly identified, connected and calibrated. Check to include correct field inputting and setting of control modes and action.
2. Wiring to all field-mounted devices which are not directly connected into electrical control circuits are to be given an electrical continuity check.
3. Record all test results on forms approved by Construction Manager.
4. The Construction Manager reserves the right to inspect and witness all tests, to reject any testing procedures, and to have any instruments realigned and/or recalibrated to give an accurate operable system.

END OF SECTION

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SECTION 15990

TESTS AND ADJUSTMENTS, OPERATING INSTRUCTIONS

PART 1 - GENERAL

1.1 INSTRUMENTS AND TEST EQUIPMENT

- A. Furnish all necessary temporary equipment and instruments required for adjustments and for operating tests, including safety relief device for use during testing. Gages used for testing to have a range of not less than 1-1/2 nor more than 4 times the test pressure. Instruments used for tests are to be maintained under calibration program as specified in Section 01100.

1.2 WITNESSING TESTS

- A. Before a test is to be made, notify the Construction Manager and approving authority having jurisdiction not less than 7 days before any on-site test is scheduled to start. Such representatives will have the right to defer the start of any test or the start-up of any system by not more than two work days if the proposed date conflicts with other commitments of the personnel assigned to witness the tests. All tests to prove tight to the satisfaction of the Construction Manager.

PART 2 - PRODUCTS

(NOT APPLICABLE)

PART 3 - EXECUTION

3.1 PIPING PRESSURE TESTS

- A. Test piping which is to be insulated, before insulation is applied. Test underground piping after pipe has been laid in the trench, but prior to backfilling of pipe trench.
- B. Disconnect devices, equipment and attached piping which are not designed for the test pressure, and install plugs and blind flanges to close openings.
- C. Underground Treated Water (TWX1), Ground Water (GW1) and Contaminated Effluent (CE1) Piping: Test and prove tight at a hydrostatic pressure of 150 psig, held for a minimum period of three hours. During this time, the pipe is to be maintained at a test pressure by the periodic addition of makeup water to compensate for stretching of the pipe. All joints to be visually examined to assure tightness.
- D. Outfall sewer (ST1) Piping: Test and prove tight at a hydrostatic pressure of 75 psig, including all manholes downstream of Manhole No. 176B, held for a minimum pressure of three hours. During this time, the pipe is to be maintained at a test pressure by the periodic addition of makeup water to compensate for stretching of the pipe. All joints to be visually examined to assure tightness.

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- 0029:
- E. Above Ground Treated Water (TWX1), Ground Water (GW21) and Contaminated Effluent (CE2) Piping: Test and prove tight at a hydrostatic pressure of 125 psig, held for a minimum period of two hours for each test.
  - F. Replace work found defective, or repair if so directed. After replacement or repair, test work again as specified. Repeat until satisfactory test is performed.

### 3.2 EQUIPMENT AND SYSTEMS

- A. Place in operation and adjust all equipment and systems.
- B. For starting up and adjusting which is not within the normal function or capacity of the Subcontractor's personnel, arrange and pay for the services of employees of the manufacturers of the various major items of equipment to supervise such adjustment and initial operation. If the Subcontractor elects to provide such service for any equipment with his own personnel, and this proves unsatisfactory, the Subcontractor must, upon notification of such dissatisfaction, arrange immediately for services of manufacturer's employees as specified hereinbefore.
- C. Take all necessary readings to determine that equipment is operating satisfactorily.
- D. Check all equipment during operation. If excessive vibration of equipment is noted, have a representative of the manufacturer check shafts, motors, motor supports, fan wheels, sheaves, equipment mountings, bearings, couplings and other components of the equipment which is vibrating. Make all corrections necessary to eliminate the vibration to obtain satisfactory performance.

### 3.3 TEST REPORTS

- A. Keep complete and accurate records of test data. After all tests have been completed, or at intervals during the testing if directed by the Construction Manager, submit in triplicate, typewritten reports of all test data. Data to include test pressures and duration of test, air quantity at each opening, fan speeds, static pressures, water flows, fan and pump motor load readings and motor nameplate data.

### 3.4 OPERATION OF SYSTEM

- A. Subcontractor to submit a detailed operation and testing procedure to the FEMP Operating Contractor for review.
- B. After the entire system has been tested and adjusted, operate it for not less than two working days of not less than 7 hours each to demonstrate that performance is satisfactory and that each item of equipment has the capacity specified. Correct all operating deficiencies observed during the test runs.
- C. When the Construction Manager deems it necessary to do so, make another test after corrective work is completed for the full period specified hereinbefore, without cost to the Operating Contractor.

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3.5 OPERATING INSTRUCTIONS

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- A. Instruct the Operating Contractor's personnel in the details of operation and maintenance of all Subcontractor-furnished equipment. Base instructions on the operating manuals furnished for the equipment, and demonstrate procedures and methods described in the manuals.

3.6 ADJUSTMENT AFTER ACCEPTANCE OF WORK

- A. Provide all services necessary to assure the proper operation of all systems for one year after final acceptance.

END OF SECTION

SECTION 16050

16050 - BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. In general, work under this section to include installation requirements for other sections of Division 16.

1.2 CODES AND STANDARDS

A. Furnish materials and equipment which are new, products of reputable manufacturers conforming to the requirements of applicable standards and recommended practices of authorities listed below and which conform to those standards and recommended practices in design, manufacture, ratings and tests.

1. American National Standards Institute (ANSI).
2. Institute of Electrical and Electronic Engineers (IEEE).
3. Insulated Cable Engineers Association (ICEA).
4. National Electrical Manufacturers Association (NEMA).
5. Underwriters Laboratories Inc. (UL), including product directories.
6. American Society for Testing and Materials (ASTM).
7. Factory Mutual (FM) "approval guide" and "loss prevention data".
8. Electrical and Electronics Graphic Symbols and Reference Designations ANSI/IEEE Y32E.
9. General Services Administration, Federal Supply Service, "Federal Standards" and "Federal Specifications."

B. All work to comply with the following:

1. Department of Labor "Occupational Safety and Health Standards," Title 29, Code of Federal Regulations (CFR), Part 1910 (OSHA), and Part 1966 (Safety and Health Regulations for Construction).
2. National Electrical Code (NEC).

3. National Electrical Safety Code (NESC).
  4. National Fire Protection Association (NFPA).
  5. Ohio Basic Building Code (OBBC).
  6. Federal, State and Local Codes.
  7. DOE 6430.1A, "General Design Criteria Manual."
  8. Uniform Building Code (UBC), Section 2312 "Earthquake Regulations."
  9. American Welding Society (AWS), Structural Welding Code (AWS D1.1).
- C. Provide equipment and materials having features and characteristics as required so that the completed facilities comply with all applicable safety requirements.
- D. Contract drawings and/or specifications govern where more strict than laws, ordinances, applicable standards of UL, NFPA, and NEC, even though such additional work is not required by local authorities, agencies, or any law or ordinances.
- E. Provide materials and equipment bearing certification of UL where such labels or stamps are customary, required, or specified.
- F. All work and materials to be such that the completed facilities comply with all applicable requirements of seismic zone 2 (OBBC).

### 1.3 PERMITS AND INSPECTIONS

- A. Obtain required licenses and permits and, at completion of work, certificates of final inspection by authorities having local jurisdiction. Pay all charges and expenses in connection therewith. Deliver inspection certificates as directed.
- B. Within 30 days after award of contract, submit to local authority and/or other authorities or agencies having jurisdiction, such working and layout drawings as that authority or agency may require. Provide services of a qualified engineer, if required by the approving agency or authority, to prepare drawings. Obtain approval before proceeding. Furnish to Owner's Representative two sets of stamped and approved drawings.

### 1.4 MANUFACTURERS' NAMES

- A. Listing of a manufacturer's name for any material or equipment does not necessarily imply acceptance of that manufacturer's product unless it complies with standards and detail specifications relating thereto.

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## 1.5 SHOP DRAWINGS

- A. In addition to the submittals requirements of these specifications, submit shop drawings containing or marked with identification and information described below. Any shop drawings not in compliance with these requirements will be returned without review for correction and resubmittal.
- B. Assemble and submit, in logically arranged folders, all instruction bulletins, diagrams, lubrication schedules, operation instructions, parts lists and pamphlets for electrical equipment and apparatus furnished, including vendor's or manufacturer's recommended procedure for lifting and handling equipment.
- C. Shop drawings to include manufacturer's model number or catalog number, ratings, size, and performance curves and data. Indicate operating point on curves and tabular data for each piece of equipment that curves or data represent.
- D. Submit wiring diagrams or connection diagrams accompanied by adequately defined symbols list.

## PART 2 - PRODUCTS

### 2.1 TEST EQUIPMENT

- A. Biddle "Megger Earth Tester".
- B. Biddle "Megger".
- C. Instruments used for tests are to be maintained under a documented regular calibration program, with calibration labels visible for inspection.

### 2.2 METAL PRIMER PAINT

- A. Paint for prime painting to be one of the following metal primers:
  - 1. Porter No. 295 U-Prime.
  - 2. Sherwin-Williams Kemkromik.
  - 3. Pratt and Lambert No. C-107 Gray.

### 2.3 NAMEPLATES

- A. Nameplates to be engraved laminated phenolic, black letters on white background, 1 inch high by 3 inches wide, or other acceptable smaller size.

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PART 3 - EXECUTION

3.1 TESTING PROCEDURES AND REQUIREMENTS

- A. Perform resistance tests on main ground loop by the "Fall of Potential" method using a Bidle "Megger Earth Tester" with two reference electrodes with resistance between test electrodes not to exceed 5 ohms. The resistance between test electrodes and main ground loop is not to exceed 5 ohms. Correct as necessary by lengthening ground rods or installing more rods. Retest and correct until 5 ohms or less is attained.
- B. Make tests and arrange for inspections necessary to determine that wiring and equipment installed under these specifications are in satisfactory condition to be energized. Schedule tests and inspections at times satisfactory to the Owner's Representative to enable him to be present. All parts of the installation, when tested, to meet applicable standards.
- C. Furnishing and setting up of required test equipment and performance of work incidental to making tests is a part of work under this division.
- D. Replace any work and equipment provided under this division and found faulty or defective under test. Should the construction manager agree, faulty or defective work and equipment may be repaired rather than replaced. After replacement or repair, test work again. Final acceptance of work depends on successful completion of operational tests on all equipment to show that the equipment will perform the functions for which it is specified.
- E. If, prior to relocation or reconnection, any existing equipment to be reused is found faulty, defective, or damaged, immediately notify the Owner's Representative for disposition.
- F. Upon receipt of Owner-furnished equipment, equipment furnished under other divisions or equipment furnished under other specifications for installation under this division, immediately inspect equipment for damage, defects and missing components. If such conditions are found which make the equipment unsuitable for installation, immediately notify Owner's Representative for disposition.
- G. Prior to making alterations or additions to existing equipment or systems, check such existing equipment or systems for proper operation. If equipment or systems are found to be faulty, damaged, or inoperative so as to be unsuitable for alteration or addition, immediately notify Owner's Representative for disposition.
- H. Instruments used for tests are to be maintained under a documented regular calibration program, with calibration labels visible for inspection.
- I. Perform continuity and operational tests on all lighting circuits and power circuits.
- J. Check all control and interlocking wiring for proper operation. Perform operational tests with Owner's Representative to assure that control wiring has been properly installed.
- K. Test all convenience receptacles for correct wiring by use of a receptacle circuit tester such as Hubbel Cat. No. 5200.

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- L. Test all ground fault circuit interrupter (GFCI) receptacles and circuit breakers for proper operation using external test device.
- M. Test all signal, alarm, and miscellaneous auxiliary systems for satisfactory operation and performance at each outlet and equipment location.
- N. Insulation Resistance Test:
  - 1. Perform insulation resistance test on circuits and motors after installation and before energization using Biddle Megger test sets, or approved equal.
    - a. For 480 volt circuits use a 1,000 volt test set.
    - b. For lower voltage circuits use a 500 volt test set.
  - 2. Investigate causes and take appropriate remedial action when either:
    - a. Insulation resistance tests are less than 5 megohms
    - b. Multiple tests indicate a significant downward trend in the resistance readings.
- O. Do not perform Insulation resistance test on circuits operated below 120 volts nor on solid-state equipment or static ground fault devices, including ground fault circuit interrupters, nor on any circuit connected to equipment containing solid-state devices, unless such test is authorized by, and is performed in strict accordance with, equipment manufacturer's recommendations, or in lieu thereof, disconnect equipment from the circuit.
- P. Inspect all ground connections for continuity and tight electrical and mechanical connections. Test resistance at various points on grounding system, using Biddle Ground Ohmer, or approved equal, or other standard method. Maximum permissible grounding system resistance is 5 ohms.
- Q. Motor Control Tests and Inspections:
  - 1. For each motor, inspect and record:
    - a. Motor - Manufacturer, horsepower, voltage, phase and full load amperes.
    - b. Motor starter - Manufacturer, size and catalog number.
      - 1) Motor circuit protector - Type and trip rating.
      - 2) Overload relay heater elements - Size and catalog number.
    - c. Description of the motor drive.
  - 2. For each motor, ascertain that size of heater element, as determined in the heater element selection table of the starter manufacturer, corresponds to motor full load current and ambient temperature experienced by motor and starter, and that motor will start and operate.
  - 3. If motor will not operate satisfactorily, notify construction manager immediately. Where directed, install next larger size overload relay heater element.

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4. Record above data in tabular form and furnish one copy to the Owner's Representative, and include tabulation in operating manual.
5. Where data of the overload relay heater manufacturer stipulates a maximum branch circuit protective device size, limit the branch circuit protective device size to that maximum size, in accordance with NEC requirements.

### 3.2 TEST REPORTS

- A. Keep complete and accurate records of test data. After all tests have been completed, or at intervals during the testing if directed, submit in triplicate, typewritten reports of all data. Data to include resistance readings, date and hour of tests, elapsed hours since last rainfall (for ground loop test only), and other pertinent data relating to specified tests.

### 3.3 CUTTING AND PATCHING

- A. Where sleeves, framing or forming have not been placed for proper installation of work, obtain from the construction manager the locations necessary to continue with construction operation.
- B. Patch such openings in accordance with applicable requirements specified under other divisions of these specifications by workers skilled in the trade involved.
- C. Neatly band holes cut in gratings. Where gratings are galvanized, immediately coat the banding and any abraded surfaces with two coats of zinc rich paint as specified hereinafter.
- D. Insofar as possible, avoid making holes in structural steel. If holes are required, obtain construction manager's permission and drill or punch holes in structural steel; do not cut with torch.

### 3.4 PRIME PAINTING

#### A. GENERAL

1. Unless factory finish is specified, or prior painting is part of manufacturer's standard procedure, prime paint fabricated or manufactured equipment and material prior to, or immediately after, installation as hereinafter specified.
2. Items not included:
  - a. Galvanized or similar treated surfaces unless furnished as part of unitary assembly.
  - b. Nonferrous surfaces.
  - c. Nonmetallic surfaces.
  - d. Plated surfaces.
  - e. Stainless steel surfaces.

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- f. Inside of conduits and devices.
  - g. Wearing surfaces.
3. Thoroughly clean and reprime shop coated materials or equipment which show evidence of corrosion.
- B. Painting: Clean all surfaces to remove dirt, oil, grease, dust, scale, rust and foreign matter before applying paint. Prepare surfaces and apply paint in accordance with paint manufacturer's recommendations.

### 3.5 OPENINGS, PENETRATIONS AND SEALS FOR CONDUIT

#### A. Sleeves for Single Conduits:

- 1. Provide a schedule 40 pipe sleeve for each single conduit which penetrates building walls or abovegrade concrete floors. Use pipe two sizes larger than conduit. Pack void between conduits and pipe sleeve with Oakum where conduit passes through sleeve in exterior walls above or belowgrade. Fill ends of sleeves with General Electric silicone foam RTV 851, or approved equal, and trowel neatly to make seal. Pipe sleeves in walls to be flush with wall surfaces and pipe sleeves in floors to be extended 1-1/2 inches above finished floor.
- B. Slots in Walls for Multiple Conduits: Where a slot is indicated or required for a group of conduits passing through an interior wall, set a rectangular frame of structural angles, welded together, in the slot, at each side of the wall. Provide a No. 16 USG steel closure plate for each side of opening, cut to fit conduits closely and fastened to angle frame.
- C. Hydrostatic Seals for Single Conduits: Provide standard weight steel pipe sleeves centered on conduits through walls or floors. Sleeve size to be as recommended by the modular mechanical seal manufacturer. Close the annular space between conduits and sleeves with Thunderline "Link-Seal" modular mechanical type seal assembly, or approved equal. Each seal assembly to be sized as recommended by the manufacturer to fit the conduit and sleeve.

### 3.7 NAMEPLATES

- A. Provide nameplate for each of the following items of equipment, and as additionally indicated, to indicate designation or purpose.
  - 1. Circuit Breaker.
  - 2. Disconnect Switch.
  - 3. Control or Alarm Device.
  - 4. Panelboard.
  - 5. Transformer.
  - 6. Motor control center and each compartment.

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7. Major component of auxiliary system.
- B. All electrical utilization equipment and receptacles to have their sources of power identified using nameplates. Fasten nameplate to equipment, receptacle or device plate as appropriate, and to its disconnecting means. Coordinate nomenclature with construction manager so as to be consistent with plantwide identification methods.
  - C. If not indicated, submit nomenclature for review.
  - D. Provide suitable steel mounting plate adjacent to equipment and fasten nameplate thereto when size, contour, or NEMA classification of the enclosure prohibits fastening nameplate to equipment.
  - E. Where control apparatus is mounted on equipment, nameplates are not required.

### 3.8 APPEARANCE

- A. Give special attention to the appearance of all facilities exposed to view, and install material and devices as required to give a neat and orderly appearance.
- B. Where exposed to view, install raceways, materials and devices parallel or perpendicular to structure lines. Install devices and panels in alignment with one another, with construction installed under other divisions of these specifications and, where appropriate, with existing devices, panels and construction.
- C. Where installation height for devices is not indicated or where there is any question as to the appearance of the installation, locate devices as directed by the Construction Manager.

### 3.9 FIELD CONDITIONS

- A. Coordinate work with the various trades involved in the project to fit available space. If there is any question as to where electrical system components should be located so that the work of other trades can be properly installed, meet and discuss such questions with the other trades involved, jointly prepare sketches or coordination drawings if necessary, and otherwise coordinate the work. Any work installed in such locations as to prevent other trades from installing their work with reasonable convenience must be relocated at no additional contract cost.
- B. Drawings indicate desired position of equipment. Unless dimensioned, raceway routing is shown schematically. Do not install raceways in locations which would make impossible the work of other trades. Coordinate work with other trades to avoid interferences. If conditions are encountered which make indicated arrangements impossible or impractical, submit request for deviation with drawings as required to clarify the request.

### 3.10 PHASE ROTATION AND IDENTIFICATION

- A. Maintain NEMA phase positions in all electrical equipment connections.
- B. Tag each terminal of motors and equipment with phase markings as an aid in making proper wiring connections and to assure correct rotation.

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- C. Check direction of rotation of all motors and reverse rotation if necessary.

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### 3.11 WORK ON ENERGIZED CIRCUITS AND EQUIPMENT

- A. Certain existing facilities will remain in service throughout construction with only brief shutdown periods permitted for tie-in connections. Schedule shutdown periods to conform to operating contractor's and Construction Manager's requirements, and only with written authorization from the construction manager.
- B. When it is necessary to perform portions of work on or adjacent to energized equipment, use only personnel qualified and experienced in such operations, and take proper safety measures to protect personnel and equipment.
- C. All energized circuits to be worked on are to be locked-out and tagged in accordance with FMPC 719.

### 3.12 ALTERATIONS AND REHABILITATION OF EXISTING INSTALLATIONS

- A. Remove, alter, reinstall and rewire existing electrical equipment, devices, outlets, conduit and wiring as required.
- B. For equipment to be relocated, disconnect and tag electrical connections prior to relocation.
- C. Cap conduit ends, provide covers for openings left in panelboards, outlets and raceways to provide a finished flush appearance where work has been removed.
- D. Where directed by Owner's Representative, take possession of wiring, conduit and miscellaneous electrical equipment removed and not reused, and released in writing by the Owner, and promptly remove these materials from jobsite unless otherwise indicated.
- E. Remove feeders or circuits to equipment being removed back to the source of supply. If other equipment, outlets or receptacles (to remain) are supplied by the same feeders or circuit, provide wiring to maintain the equipment, outlets or receptacles in service and remove unused portions of feeder or circuits to the nearest junction box and tape ends of conductors.
- F. Disconnect and remove or relocate electrical items affected by demolition work and where interference exists at facilities to be extended.
- G. All phases and scheduling of work to be closely coordinated with the Owner and other trades, and authorized in writing by the Owner at least 1 week prior to the execution of any work. Disconnect and reconnect electrical services as required by other trades.
- H. Schedule the work to minimize electrical circuit outages and downtime periods. Make temporary connections where necessary to maintain operation of existing systems. Replace temporary wiring with permanent wiring as soon as practicable.
- I. When specific types of equipment, methods of connection, disconnection or relocation are not indicated, provide equipment, devices, wiring and workmanship compatible with the existing system and satisfactory to the system manufacturer and Owner's Representative.

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3.13 RESTORATION OF EXISTING FACILITIES

- A. Replace or restore to their original undamaged condition all facilities damaged during progress of work. Such replacement or restoration applies to both surface and subsurface installations and materials. Use materials and installation methods to match existing installations. All repairs to be made by skilled craftsmen of trades involved at no additional cost to the Owner.

3.14 INSTALLATIONS IN HAZARDOUS AREAS

- A. Not Used.

3.15 PROTECTION OF PROPERTY

- A. Protect equipment and materials from intrusion of all foreign materials. Do not install sensitive electrical equipment (such as motor controls, etc.) until major construction work is completed. During and after installation, protect equipment from damage by water, dust, paint, wet concrete, impact, etc.

3.16 SUPPORTS FOR EQUIPMENT

- A. Provide all necessary supports for equipment provided or installed under this division. Supports to consist of steel frames, plates, brackets, racks and other shapes of adequate size and fastened with bolts, screws or by welding, to provide rigid support of sufficient strength.
- B. Welds to be continuous and reasonably smooth. Surfaces to be suitably protected from the environment. Acceptable methods include full galvanizing after refabrication or covering with metal primer paint. Where paint is used, maintain tight control on each step of the operation from surface preparation, through primer and to final finish coats.

3.17 ACCESS

- A. Provide access for all items requiring inspection or maintenance, such as junction, pull and outlet boxes and sealing fittings.

END OF SECTION

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SECTION 16100

WIRING METHODS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Raceway systems and associated boxes and hardware.
2. Wiring, 600 volts and less.

B. Related Work in Other Sections:

1. General electrical requirements.
2. Cutting and patching.
3. Excavation and backfill.
4. Concrete.
5. Painting.

1.2 QUALITY ASSURANCE

- A. Conform to ANSI/NFPA 70, "National Electrical Code."
- B. Furnish products listed by Underwriters Laboratories Inc. and classified as suitable for installed use and environmental conditions.
- C. Contractor to be responsible to determine, for each item of equipment furnished, whether special wiring is required, and to provide that type of wiring.
- D. Comply with NEMA/ICEA standards as applicable to construction.
- E. Comply with applicable requirements of NEMA standards pertaining to raceways.
- F. Except for underground work, intermediate metal conduit may be substituted for rigid steel conduit.

1.3 DELIVERY, STORAGE AND HANDLING

- A. Deliver wire and cable properly packaged in factory-fabricated type containers, or wound on NEMA-specified type wire and cable reels.
- B. Store wire and cable in clean dry space in original containers. Protect products from weather, damaging fumes, construction debris and traffic.

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- C. Handle wire and cable carefully to avoid abrading, puncturing and tearing wire and cable insulation and sheathing. Ensure that dielectric resistance integrity of wires/cables is maintained.
- D. Deliver, store and handle raceway components carefully so as to avoid physical damage and deformation. Protect against damage to paint and/or protective coatings.

## PART 2 - PRODUCTS

### 2.1 CONDUIT SYSTEMS

- A. Use rigid, galvanized threaded steel conduit with all cast ferrous metal outlet boxes, junction boxes and conduit bodies, except as otherwise indicated.
- B. Use liquidtight flexible metal conduit in wet locations where flexibility is required and for all motor and transformer connections.
- C. Minimum conduit size 1/2 inch.
- D. Rigid Steel Conduit:
  - 1. Acceptable Manufacturers:
    - a. Allied Tube and Conduit.
    - b. Steelduct.
    - c. Triangle - PWC.
    - d. Wheatland Tube.
  - 2. Hot-dip galvanized, threaded, rigid steel in accordance with UL 6 and ANSI C80.1.
- E. Intermediate Metal Conduit:
  - 1. Acceptable Manufacturers:
    - a. Allied Tube and Conduit
    - b. Triangle - PWC
  - 2. Hot-dip galvanized, threaded rigid-type steel in accordance with UL 1242.
- F. PVC Conduit:
  - 1. Acceptable Manufacturers:
    - a. Carlon
    - b. Can-Tex

2. Schedule 40 rigid PVC conduit, rated for 90C cable in accordance with UL 651 and NEMA TC-2. Fittings to be of same manufacturer and type as the conduit, installed with solvent cement in accordance with manufacturer's recommendations.

G. Liquidtight Flexible Conduit:

1. Acceptable Manufacturers:

- a. Anaconda Industries - Sealtite Type UA.
- b. Electri-Flex LA.
- c. Liquatite LA.
- d. O-Z/Gedney Flexi-Guard Type UAG.

2. UL listed, concave single strip, helically wound galvanized steel strip interlocked and tightly jointed, the whole covered with a continuous liquidtight PVC jacket. Extra-flexible non UL-listed types will not be acceptable.

H. Conduit Bodies:

1. Acceptable Manufacturers:

- a. Appleton.
- b. Crouse-Hinds.
- c. Pyle-National.
- d. Raco.

2. Unless otherwise indicated, all conduit bodies for rigid steel to be threaded ferrous alloy type. Neoprene gasketed covers with blind captive screws. Covers to be cast type.

I. Couplings, Fittings and Connectors:

1. Acceptable Manufacturers:

- a. Appleton.
- b. Efcor.
- c. O-Z/Gedney.
- d. Pyle-National.
- e. Steel City.
- f. Raco.

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g. Thomas & Betts.

2. For liquidtight flexible metal conduit, use O-Z/Gedney "ground-tight" type 4QLT, or equal, grounding liquidtight connectors with insulated throats.

## 2.2 BOXES

### A. Luminaire Outlet and Junction Boxes:

1. For exposed work, use Crouse-Hinds GRFX, or approved equal, threaded 4 inch cast ferrous metal boxes..
2. For pendent luminaires, Crouse-Hinds type AL, or approved equal, ball aligner type hanger outlets suitable for seismic zone 2.

### B. Switch, Receptacle and Special Boxes:

1. Crouse-Hinds, or Appleton FS or FD series bodies for exposed work. Boxes threaded for rigid conduit.
2. For single devices installed in masonry, Raco, Steel City, or approved equal, 4 inch, solid type square corner, single device boxes.
3. Except by special permission, no gangable boxes will be allowed.
4. Where a switch outlet is indicated or used for a pull box, provide extra deep box or multigang box with device opening in the center of the cover plate.
5. Receptacle boxes which are to receive weatherproof covers are to be installed so that the lift covers will open upwards (vertically).

### C. Pull Boxes and Junction Boxes:

1. Pull boxes and junction boxes 6 inches by 6 inches by 4 inches deep minimum or sized as indicated, code gage galvanized steel, covers fastened with brass screws. For adverse environments where boxes are required to have features such as dust-tight, weatherproof, watertight or raintight, use Crouse-Hinds series "W" cast boxes, or equal.

## 2.3 FITTINGS

### A. Expansion Fittings:

1. O-Z/Gedney Type AX, Crouse-Hinds Type XD or Appleton Type XJ, weathertight expansion fitting at building expansion joints and at midpoint in long, straight runs in excess of 150 feet. Provide fitting with flat, braided bonding jumper, complete with clamps for attachment to conduits at each end of fitting.

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## 2.4 WIRE AND CABLE

### A. 600 Volts or Less:

1. Use no wire smaller than No. 12 AWG, rated at 600 volts, for power and lighting circuits and no smaller than No. 14 for control wiring, unless otherwise specified or indicated.
2. All wire, regardless of size, to be stranded copper.
4. No reduction in wire sizes based on ampacity or other reason will be permitted.
5. Contractor to be responsible to determine, for each item of equipment furnished, whether special wiring is required, and to provide that type of wiring.
6. Provide UL listed copper building wire and cable as manufactured by American, Essex, Royal, Cablec, Pirelli, Rome or Triangle - PWC, types as indicated below:
  - a. Type THHN/THWN: For lighting, power and control, all sizes.
  - b. Type THWN-2: For underground wiring.
  - c. For high temperature applications, type FEP teflon.

### B. Instrumentation Wire:

1. Use 18 gage stranded copper, twisted pair, polyethylene insulated, 100 percent, aluminum polyester shielded with 20 gage AWG drain wire, and PVC jacket rated for 300 volt, 60C. Color code: black, clear. Belden 8760, or approved equal

## 2.5 WIRING MATERIALS

### A. Tapes and Insulating Compounds:

1. 3M Company No. 33 plus Scotch Tape (7 mil vinyl plastic electrical tape).
2. Insulating compound to be Scotch 2200 pads, Scotch 2210 rolls, or equal, overwrap with Okonite Company No. 35 jacketing tape.

### B. Solderless Lugs and Connectors:

1. Use lugs or connectors of sufficient size to enclose all strands of conductors. For No. 8 AWG wire size and larger, use Burndy Servits or Thomas & Betts Lock-Tite connectors. For No. 10 AWG wire size and smaller, use spiral "Live Spring" type with color coded insulated jacket or cover, such as 3M Company "Scotchlocks", Ideal Industries Inc., "Wingnuts", Thomas & Betts "Piggy" connectors or Buchanan "B-Caps". Insulated "Wire Nuts" are not acceptable. Self-stripping connections are not acceptable.

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0018 C. Wire Identification Markers:

1. Wire identification markers to be Brady or Thomas & Betts, printed, vinyl cloth, self-adhesive strips.

PART 3 - EXECUTION

3.1 WIRING 600 VOLTS OR LESS

- A. All wiring must be installed in conduit or other acceptable raceway, unless otherwise indicated.
- B. Pull no wire, until the conduit system is completed and thoroughly swabbed. Use inert pulling compounds free of ingredients harmful to insulation. Do not use grease oil or soap.
- C. Place all wires of the same circuit in the same raceway.
- D. Install wiring continuous from outlet to outlet, without splices, except in outlet boxes, accessible junction boxes or surface metal raceways.
- E. Train and lace wiring inside equipment and panelboards with plastic wrap for workmanlike neatness. Do not lace or strap tightly any current carrying lighting or power wiring.
- F. Make all spare wires in cabinets or panelboards of adequate length for connection to most remote terminal in enclosure.
- G. Terminate spare wires with insulating tape, and tag.
- H. Insulate ends of pull wires which terminate in cabinets, panels, motor control centers or other electrical device enclosures to prevent contact with "live" terminations.
- I. Where required by NEC, support conductors in vertical raceways with supports in junction boxes.
- J. Use insulated spiral "Live Spring" wire or solderless pressure connectors. Soldered joints are not permitted. Thoroughly tape all otherwise uninsulated joints with electrical tape. Self-stripping connectors are not permitted.
- K. Install self fusing rubber-based insulating compound, molded around sharp edges and/or difficult shapes, to provide smooth surface for applying electrical tape.
- L. Thoroughly clean wires before installing lugs and connectors so that joint will carry full capacity of conductors without perceptible temperature rise.

3.3 IDENTIFICATION OF WIRING

- A. Label and color code wire and cable in accordance with NEC and in accordance with operating contractor's criteria, as follows:
  1. Handwritten or wraparound labels are not acceptable for use at the FMPC. Label all cables properly using a rectangular, flat, nonheat-shrinkable tag with 1/8 inch high

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lettering, fastened by nylon "tie-wraps" passed through prepunched holes, Raychem type TMS, or approved equal. For single conductors and individual cable wires, provide slip-on, heat-shrinkable sleeve markers, with black lettering on a white background, W.H. Brady computer-printable "Brady-Sleeve," or approved equal. Mark all spare wires and cables "SP" at both ends. Mark cables with a circuit or cable number. Mark all single conductor wire and conductors of cables with a wire number and circuit number. If several circuits are contained within the cable, also mark each conductor with a circuit number.

- B. With the exceptions noted below, locate markers at origin and destination, and at all intervening accessible splice or junction boxes. Mark all wire and cable with a cable or circuit number only.
- C. Locate wire markers within 3 inches of a termination or splice. Locate cable markers within 3 inches of the spread, cable end, penetration, or box exit.
- D. For branch circuits and all interior supply side circuits, color code as follows:
  - 1. For 120/240 VAC systems
    - a. Hot - Black
    - b. Hot - Red
    - c. Neutral - White
    - d. Ground - Green
  - 2. For 480 VAC system
    - a. Phase A - Yellow
    - b. Phase B - Orange
    - c. Phase C - Brown
    - d. Ground - Green
- E. Color code ungrounded ("phase" or "hot") conductors in sizes No.8 AWG and smaller by means of colored insulation or jacket. Where colored insulations or jackets are only available on special order, alternate methods for color coding ungrounded conductors may be approved upon request to the construction manager. Color code conductors in sizes No.6 AWG and larger by means of colored insulation or jacket, or by use of colored tape at terminals and at all points where accessible after installation.
- F. Yellow tape to consist of two separate bands at each application point in order to avoid confusion with white, gray, or orange after aging.
- G. For all conductor sizes, green, gray or white colors are reserved exclusively for grounding and grounded conductors respectively. do not use these colors in any way to identify an

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ungrounded conductor. Use gray or white, as required by the appropriate color code, only for the grounded or neutral conductor identification.

- H. Color code grounded ("neutral") circuit conductors and equipment grounding ("ground wire") conductors in sizes No.6 AWG and smaller only by means of colored insulation or jacket. Color code these conductors in sizes No.4 AWG and larger by means of colored insulation or jacket or by means of colored tape at terminals and at all points where accessible after installation.
- I. Painting, taping, or other alteration of the color of a green, white, or gray colored conductor is prohibited.
- J. Control wire to be individually color coded and numbered, and tagged at locations indicated above. Tag control wires with numbers as shown on control drawings or manufacturer's drawings.

### 3.4 LOCATION OF OUTLETS

- A. Securely anchor all outlet boxes, independent of conduit supports.
- B. In concealed locations keep outlet box openings flush with finished surfaces. Plans indicate approximate locations only, unless specifically dimensioned. Verify outlet locations in field and change if conditions require. Where new location is within a radius of 10 feet from location shown, such changes are a part of the work under this specification.

### 3.5 LUMINAIRE OUTLETS

- A. Space outlets evenly and in alignment, unless otherwise distinctly shown. Locate outlets from dimensioned building plans where spaced symmetrically with building beams or evenly spaced in building bays and rooms.

### 3.6 MOUNTING HEIGHTS

- A. Unless otherwise indicated, the following heights from center line of outlet apply:
  - 1. Control stations: 4 ft. 6 in. above finished floor
  - 2. Exit light outlets: 0 ft. 9 in. above door
  - 3. Fire alarm station outlets: 4 ft. 6 in. above finished floor
  - 4. Fire alarm signal outlets: 8 ft. 0 in. above finished floor
  - 5. Bracket and special outlets: As indicated

3.7 HANGERS AND SUPPORTS

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A. General:

1. Provide supports for conduit, boxes and hardware fabricated with cold formed metal framing or structural steel, rigidly welded or bolted to present workmanlike appearance. Use hexagon head bolts with spring lock washers under all nuts.
2. Do not support conduits, boxes or hardware from piping, ductwork, ceiling support system, metal roof or floor deck, or other such facilities. Unless otherwise indicated, support conduits only from structure.

B. Conduit Supports:

1. Arrange conduit supports to prevent distortion of alignment by wire pulling operations. Provide galvanized steel hangers, clamps and malleable iron galvanized conduit straps. Perforated pipe straps will not be accepted. Fasten hangers to building steel with mechanical beam clamps. Use toggle bolts in hollow masonry walls, and expansion shields in concrete or brick walls. Trapeze hangers with conduit clamps may be used where groups of conduits run parallel. Provide a support at each elbow or conduit body.

3.8 CONDUIT SYSTEMS

- A. Cut conduits square and carefully ream ends. Bring joints to a shoulder. Securely fasten conduits to sheet metal outlet, junction and pull boxes with galvanized double locknuts and insulating bushings, except where required by the NEC, such as with service raceways, or with raceways in or intervening between hazardous areas and point of service ground, provide suitable bonding fittings. Use care so that sufficient threads project through to permit bushing to be drawn tightly against end of conduit. Do not install conduit with rusty threads.
- B. Where conduit systems cannot otherwise be constructed use unions, Erickson type or threaded split type couplings. Where split couplings are used ensure threads of conduits and couplings are matched prior to final tightening.
- C. Run exposed conduit parallel with, or perpendicular to, members of the structure.
- D. Ring pipe or trapeze hangers may be used to support conduits except for the first and last hangers of the conduit run or where a vertical or horizontal direction change occurs. In these cases, rigidly brace conduit supports so that wire may be pulled without damage to the conduit system. Stud welds may be used for fastening clamps to steel. Do not use flat straps to support conduit or boxes.
- E. Seal conduits stubbed up or terminating in cabinets, outlets, switchgear and similar equipment against entrance of foreign matter into system by use of appropriate conduit pennies and retaining bushings prior to swabbing and pulling in wire.
- F. Provide nylon pulling line or pulling wire, as applicable, in all empty conduits provided under these specifications.
- G. Avoid moisture traps where possible. Where unavoidable, provide drain fittings at low points.

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- H. Install Crouse-Hinds type EZS seal fittings, or equivalent Appleton, or approved equal, at all points where conduits pass from hot to cold locations and from inside to outside of building walls and roofs. Pack seal fittings, in nonhazardous areas with nonhardening duct sealing compound, Graybar Permagem, or equal.
- I. Do not install conduits closer than 6 inches to parallel runs of flues, steam lines, hot water pipes or other pipes carrying materials hotter than 200F.
- J. Liquidtight flexible metal conduit where flexibility is required and for all motor and transformer connections.
- K. Minimum conduit size 1/2 inch.
- L. Seal underground conduits entering buildings per NEC.
- M. PVC conduit to be used underground change to steel conduit before turning up out of ground or before entering building. Where turning up use steel elbow, change to steel 5 feet before entering building.

### 3.9 BOXES

- A. Support boxes independent of raceway systems.

END OF SECTION

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SECTION 16141

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WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Wall switches.
  - 2. Receptacles.
  - 3. Device plates and box covers.
- B. Related Work in Other Sections:
  - 1. Wiring and conduits.
  - 2. Outlet boxes.

1.2 QUALITY ASSURANCE

- A. Provide devices listed by Underwriter's Laboratories Inc., of specification grade where such rating is applicable, and suitable for installed use and environmental conditions.
- B. Standards:
  - 1. Wall Switches in accordance with NEMA WD1 and FS W-S-896.
  - 2. Receptacles in accordance with NEMA WD1 and FS W-C-596 as applicable.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Color:
  - 1. Switches and convenience receptacles: Brown.
  - 2. Power receptacles: Manufacturers standard color of black or brown.

2.2 WALL SWITCHES

- A. Acceptable Products: Provide products of Hubbell as specified hereinafter or equivalent products as manufactured by:
  - 1. Leviton.

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2. Arrow Hart.
  3. Pass and Seymour.
- B. Quiet Toggle Type: Hubbell No. 1221, 1222, and 1223. 20 amperes, 120-277 volts AC, side and back wired.

### 2.3 CONVENIENCE RECEPTACLES

- A. Acceptable Products: Provide products of Hubbell as specified below or equivalent products as manufactured by:
1. Leviton.
  2. Arrow Hart.
  3. Pass and Seymour.
- B. Duplex Type:
1. 20 amperes, 125 volts, 2-pole, 3-wire, Hubbell No. 5362, grounding type, NEMA Configuration 5-20R.
- C. Convenience Duplex, Lock Type: Hubbell No. 4700 Twist-Lock, 15 amperes, 125 volts, 2-pole, 3-wire, grounding type. NEMA Configuration L5-15R.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Installation heights:
1. Wall switches: 54 inches above floor, OFF position down.
  2. Convenience receptacles in unfinished areas: 54 inches above floor.
  3. Install specific-use receptacles at heights directed if not shown on Contract Drawings.
- B. Install cast metal plates on outlet boxes and junction boxes in unfinished areas, and on surface-mounted outlets.

END OF SECTION

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SECTION 16300

MEDIUM VOLTAGE DISTRIBUTION

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PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pad-mounted transformers.
2. Cable.
3. Cable terminations.
4. Cable separable connectors.
5. Duct bank.

B. Related Work in Other Sections:

1. General electrical requirements.
2. Excavation and backfill.

1.2 QUALITY ASSURANCE

- A. Conform to ANSI/NFPA 70, "National Electrical Code."
- B. Conform to ANSI C2, "National Electrical Safety Code."
- C. Furnish products listed by Underwriters Laboratories where applicable.
- D. Use PVC conduit in duct bank.
- E. Duct system to consist of single round bore conduits. Conduits not perfectly circular will not be permitted. Protect conduit in stockpiles pending installation to prevent deformation.

1.3 DELIVERY, STORAGE AND HANDLING

- A. Deliver wire and cable properly packaged in factory-fabricated type containers, or wound on NEMA-specified type wire and cable reels.
- B. Store wire and cable in clean dry space in original containers. Protect products from weather, damaging fumes, construction debris and traffic.
- C. Handle wire and cable carefully to avoid abrading, puncturing and tearing wire and cable insulation and sheathing. Ensure that dielectric resistance integrity of wires/cables is maintained.

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- 0528 D. Deliver, store and handle raceway components carefully so as to avoid physical damage and deformation. Protect against damage to paint and/or protective coatings.

## PART 2 - PRODUCTS

### 2.1 PAD-MOUNTED TRANSFORMER

- A. Pad-mounted compartmental-type transformer with 13,200 volt, 60 HZ delta primary and secondary are indicated on the drawing. Terminal compartments shall be sized as required for specific equipment and terminations installed. Provide weatherproof padlocks of keying and type directed by Owner. Each factory assembled metal-enclosed center to transformer tank, high voltage cable terminating compartment and a low-voltage cable terminating compartment in an integral tamperproof enclosure suitable for mounting on a concrete pad. There are to be no exposed fastening devices such as screws or bolts which are externally removable. No openings through which rods, sticks, wire or other foreign objects might be inserted to contact live parts will be acceptable. The full height high and low voltage compartments with hinged doors (capable of being latched in the open position) to be located adjacent to each other on one side of the transformer tank and be separated by a suitable barrier. High voltage compartment to be accessible only after door to low voltage compartment has been opened.
- B. Transformer section to be mineral-oil immersed, sealed-tank construction, self-cooled, 3-phase, 60 HZ, two-winding type with four 2-1/2 percent high voltage taps (two above and two below rated primary voltage). Manual tap changer to be arranged for tap changing only when the transformer is deenergized. All taps to be rated for full load capacity. Transformer section to include all standard accessories and maintenance devices (sampling valve, dial-type thermometer, liquid level gage, etc.). Fittings for sampling of insulating oil to be accessible without exposure of personnel to the primary voltage of a fully loaded transformer. Immediately prior to energizing, make up any oil deficiencies with new suitable oil before placing the units in operation. Minimum impedance 3.5 percent.
- C. Incoming primary section to consist of an air-filled terminal compartment, lightning arrestors, oil immersed bayonet type fuses, and cable terminators for the primary cable arranged for cables entering from below. The incoming section to contain three lightning arrestors coordinated to the transformer and to the primary distribution voltage connected to the incoming primary line. Secondary section to consist of secondary terminal compartment with ground pad, low voltage terminals, and terminal lugs sized for service feeder.
- D. Lifting provisions in accordance with ANSI Standards.
- E. Provide jacking and rolling provisions.
- F. The instruction nameplate is to be located in the low-voltage portion of the compartment and shall be readable with cables in place. Where the nameplate is mounted on a removable part, the manufacturer's name and transformer serial number to be permanently affixed to a nonremovable part.
- G. Transformer tank to provide sealed-tank construction with a welded main cover.
- H. Provisions for tank grounding to be supplied in both the high-voltage and low-voltage compartments.

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- I. Provide six 200-ampere bushing wells equipped with 200-ampere loadbreak switch modules.
- J. Provide three Bayonet-type, oil-immersed, expulsion fuses accessible through the primary compartment. The fuses to be removable using a hot stick, (without disassembly of the primary cabinet) for external replacement of fuse cartridges.
- K. Provide a 200 ampere primary selective switch to permit energizing transformer from either of two primary sources (but not both). The alternate source switch to consist of two internal, oil-immersed, gang-operated, two-position (ON-OFF), manually-operated, loadbreak switches with a mechanical interlock to prevent closing both sources. The switch must be capable of switching transformer full-load current. The switch handles be located in the primary compartment and must be hot-stick operable.
- L. Acceptable Manufacturers:
  - 1. General Electric
  - 2. Square D
  - 3. Westinghouse
  - 4. Vantran

## 2.2 PRIMARY CABLE

- A. Primary cable to be single conductor shielded power cable insulated with an ozone and discharge resistant, flexible, rubber-like thermosetting dielectric. The size and number of cables as indicated. Cables to have a voltage rating of 15,000 volts. The cable to be suitable for use in wet and dry locations in conduit, underground duct systems, direct buried and aerial installations. The cable to be rated 90C for normal operation, 130C for emergency overload operation, and 250C for short circuit conditions. Emergency overload operation may occur for periods up to 100 hours per year and with as many as five such 100 hour periods within the lifetime of the cable.
- B. Basic construction: 1/C Class B copper, extruded conductor screen, flexible thermosetting dielectric based on an ethylene-propylene type elastomer, extruded insulation screen, copper shield, and a thermoplastic jacket overall.
- C. Industry standards: Cable to meet or exceed the latest editions of the following industry specifications:

ICEA S-68-516	ASTM B-8, B-231
AEIC CS-6	UL-1072 (Type MV)
- D. Conductor
  - 1. Uncoated soft copper, Class B, stranded per ASTM-B-8 and compressed.
  - 2. Must meet electrical resistance requirements of ICEA-S-68-516, Section 2.5.2.

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E. Conductor screen

1. Extruded layer of semiconducting thermosetting compound with a volume resistivity not in excess of 50,000 ohm-cm at 90C with average 20 mil thickness.
2. The screen to be clean stripping from the conductor and firmly bonded to the overlying insulation.

F. Insulation

1. Ethylene-propylene. Must meet the electrical and physical characteristics specified in ICEA.
2. The average insulation thickness be not less than 175 mils. The minimum thickness of any cross section of the insulation to be not less than 90 percent of the average thickness.

G. Insulation screen

1. The insulation screen to be an extruded semiconducting compound with a volume resistivity not in excess of 50,000 ohm-cm at 90C.
2. Peel strength of the extruded screen from insulation to be between 4-14 pounds per 0.5 inch width.
3. The thickness of the extruded screen to be 40 mils minimum average.

H. Metallic shield

1. The outer screen/insulated core to be covered with an uncoated copper tape. It shall be applied helically with a 12-1/2 percent nominal overlap.
2. The thickness of the tape shall be .005 inches.

I. Jacket

1. Black polyvinyl-chloride meeting the requirements in ICEA Standards.
2. The jacket thickness to be 80 mils.
3. The minimum thickness at any point shall be not less than 80 percent of the specified minimum average thickness.

J. Identification

1. An identifying legend to be printed on the jacket with contrasting ink and repeated approximately every 2 feet, containing the following information:
  - a. Manufacturer's name, plant, shielded ethylene-propylene, insulation thickness in mils, AWG/CM copper and voltage rating and year of manufacture.

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K. **Manufacturer:** Basis of design for primary cables: The Okonite Company. Cables by other manufacturers which meet this specification may be proposed for use; however, a sample of the proposed cable must be submitted for approval.

L. **Acceptable Manufacturers:**

1. Okonite
2. Rome
3. Cabletec

### 2.3 SPLICES AND TERMINATIONS

- A. Splices to be heat shrink (Raychem type HVS) or built up tape type (3M Series 1700), stress relieving splice. Provide compression connectors for the wire.
- B. Terminations to be stress relief heat shrink (Raychem Type HVTI) or built up tape type (3M Series 5700) terminations with shield ground, suitable for use in transformer compartments or manhole. Provide compression type lug for the wire.
- C. All stress cones, terminators and splices shall be installed per manufacturer's recommendations.
- D. All cables passing through manholes shall be spliced.

### 2.4 CABLE TERMINATORS

- A. Cable terminations and splices to have voltage ratings of not less than 15,000 volts. The standard withstand voltage of the completed terminations to conform to IEEE Standard No. 48. Stress relief cones or tee splices shall be provided at the terminals of all shielded cable.
- B. Stress relief cone for outdoor installations: Elastimold 35MTG modular terminators complete with all required accessories for a complete termination.

### 2.5 DUCT BANKS

- A. Provide underground duct banks as indicated. Banks to consist of PVC conduits (for concrete encasement type) with 3 inch minimum concrete cover on all sides. Provide plastic spacers to hold ducts in position. Top of ducts to be 24 inch minimum below grade and top of concrete shall be permanently colored red. Connect to existing manhole at location directed by Owner (cut and patch as required). Terminate with bell ends at manholes. Provide 1/4 inch nylon pull rope in all ducts (18 inch free ends). Seal duct ends with duct sealing compound.

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PART 3 - EXECUTION

3.1 GENERAL

- A. Provide pad mounted transformer wiring and all accessories for extension of the electrical distribution system complete. The electrical distribution system must conform to the requirements of the National Electrical Safety Code.
- B. The system must be complete with all necessary accessories for proper operation. The disconnecting devices, protective devices, and all other equipment to be thoroughly coordinated to secure the required results.
- C. The equipment to be furnished under this specification to be essentially the standard product of the manufacturer.

3.2 GROUNDING

- A. Provide ground rods at each pad mounted transformer. Connect lightning arresters, neutral conductors, ground pads, conduits, and all other metallic equipment to ground.

3.3 DUCT INSTALLATION

- A. Work with extreme care near existing ducts, conduits, cables, and other utilities to avoid damaging them. Cut the trenches neatly and uniformly.
- B. Excavation and trenching:
  - 1. Perform all excavation and trenching required for installation of conduits and appurtenant items.
  - 2. Protect excavations at all times. Maintain trench banks as nearly vertical as possible. Remove excess earth and do all necessary sheet piling, shoring, bailing and pumping. Keep excavations dry. Where material is encountered that is wet or otherwise unsuitable for proper support of conduits, as determined by the Construction Manager, remove such soil to depth required for full width of trench, backfill with gravel to the proper grade and compact in accordance with the specification for backfilling.
  - 3. Backfill with selected fill acceptable to the Construction Manager, or with bank run gravel, in layers not more than 6 inches thick. Power-tamp each layer to 95 percent or greater density as measured by AASHTO T-99, method A or D, as applicable.
- C. After excavation of the trench, stakes shall be driven in the bottom of the trench at four foot intervals to establish the grade and route of the duct bank. Pitch the trenches uniformly towards manholes or drainage. Avoid pitching the ducts towards buildings wherever possible. The walls of the trench may be used to form the side walls of the duct bank provided that the soil is self-supporting and that concrete envelope can be poured without soil inclusions. Forms are required where the soil is not self-supporting. After the concrete encased duct has sufficiently cured, the trench shall be backfilled to grade with earth.

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D. Excavation, backfilling and resurfacing:

1. Do all necessary excavating, backfilling and resurfacing required for work included under this division.

E. Installation of conduits:

1. Conduit to be thoroughly cleaned before using or laying, and the ends plugged or capped during construction and after the duct line is completed. Take particular care to keep the conduits clean of concrete, dirt and any other substance during construction.
2. Where conduit cuts are necessary, make all cuts straight and true.
3. Install conduit minimum of 2 feet 6 inches to top of conduit below grade, cover duct bank with minimum of 6 inches of same.

3.4 CABLE INSTALLATION

- A. Install all cable, cable terminals and stress cones and splices per manufacturer's specifications.
- B. After the installation, provide a high potential test for the primary cable system. Select an independent testing firm and pay the costs of the initial tests for all cables. Should any installed cable fail the tests, the Contractor is to replace all cables in the duct with the subject cable or correct the problem to the Owner's satisfaction. The Owner to have the option and to decide if the problem may be corrected or if the cables must be replaced. The Contractor to bear the costs of all retests necessary due to a cable failing the initial test.
- C. The method, voltage, length of time and other characteristics of the test to be in accordance with IPCEA publication No. S-19-81, latest edition, for the particular cable installed. The independent testing firm employed by the Owner to issue a professional opinion, prepared by a registered professional engineer, for each cable tested stating whether the cable passed the test and is acceptable or the cable failed the test and is not acceptable.

END OF SECTION

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SECTION 16440

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DISCONNECT SWITCHES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Disconnect switches.
2. Fuses.
3. Enclosures.

1.2 REFERENCES

- A. ANSI/UL 198E - Class R Fuses.
- B. NEMA KS 1 - Enclosed Switches.
- C. UL 98 - Enclosed and dead front switches.
- D. Federal Specification W-S-865C with Amendments - Switch box (enclosed), surface-mounted.
- E. Federal Specification W-F-1814 A/Gen and supplements - fuse, cartridge, high interrupting capacity.

1.3 SUBMITTALS

- A. Submit product data and fuse characteristic information.

PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - DISCONNECT SWITCHES

- A. General Electric.
- B. Square D.
- C. Westinghouse.

2.2 DISCONNECT SWITCHES

- A. Fusible Switch Assemblies: NEMA KS 1; quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse Clips: Designed to accommodate Class R fuses.

**B** Nonfusible Switch Assemblies: NEMA KS 1; Type HD; single THNN, quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. The switch shall have a means of bypassing the mechanically interlocked door and handle. Handle lockable in OFF position.

C. Enclosures: NEMA KS 1; Type 3R. or as indicated on Drawings.

### 2.3 ACCEPTABLE MANUFACTURERS - FUSES

- A. Bussman
- B. Gould Shawmut.
- C. Reliance.

### 2.4 FUSES

- A. Fuses 600 Amperes and Less: RK5; dual element, rejection type, current limiting, time delay, one-time fuse, 600 volt.
- B. Interrupting Rating: 200,000 rms amperes.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install disconnect switches plumb and square. Mount securely.
- B. Install fuses in fusible disconnect switches. Mark switch for proper fuse size for future reference.

END OF SECTION

SECTION 16450

2850

GROUNDING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Power system grounding.
2. Electrical equipment and raceway grounding and bonding.

1.2 SYSTEM DESCRIPTION

- A. Provide grounding systems and all work associated therewith in accordance with the requirements of the National Electric Code, as a minimum, and as further specified herein.
- B. Ground the electrical service system neutral at service entrance equipment to grounding electrodes.
- C. Ground each separately-derived system neutral to nearest effectively grounded building structural steel member or ground ring.
- D. Bond together system neutrals, service equipment enclosures, exposed non-current carrying metal parts of electrical equipment, metal raceway systems, grounding conductor in raceways and cables, receptacle ground connectors, and plumbing systems.

1.3 SUBMITTALS

- A. Shop Drawings to indicate layout and location of system grounding electrodes, connections, and routing of grounding electrode conductor.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Ground Rods: Copper-encased steel, 3/4 inch diameter, minimum length 10 feet.
- B. Exothermic Welding: Heavy duty Cadweld or heavy duty Thermoweld.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Provide a separate, insulated equipment grounding conductor in feeder circuit conduits. Terminate each end on a grounding lug, bus, or bushing.

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- B. Install a grounding system and ground rods as shown. Make underground ground grid connections and connections to ground rods by an exothermic weld process. Make above ground connections by exothermic weld process or with pressure type ground connections
  - C. Provide grounding and bonding at pad-mounted transformer.

### 3.2 FIELD QUALITY CONTROL

- A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.
- B. Measure ground resistance from system neutral connection at service entrance to convenient ground reference point using suitable ground testing equipment. Resistance shall not exceed 5 ohms.

END OF SECTION

SECTION 16461

2850

DRY TYPE TRANSFORMERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Low voltage dry type two winding transformers.

1.2 SUBMITTALS

- A. Include outline and support point dimensions of enclosures and accessories, unit weight, voltage, KVA, and impedance ratings and characteristics, loss data, efficiency at 25, 50, 75 and 100 percent rated load, sound level, tap configurations, insulation system type, and rated temperature rise.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Store in a warm, dry location with uniform temperature. Cover ventilating openings to keep out dust.
- B. Handle transformers using only lifting eyes and brackets provided for that purpose. Protect units against entrance of rain, sleet, or snow if handled in inclement weather.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. I-T-E.
- B. General Electric.
- C. Square D.
- D. Westinghouse.

2.2 DRY TYPE TWO WINDING TRANSFORMERS

- A. Dry Type Transformers: ANSI/NEMA ST 20; factory-assembled, non-ventilated dry type transformers; ratings as indicated.
- B. Insulation system and average winding temperature rise for rated KVA as follows:
1. KVA Rating 1-15: 220 degree C insulation system; 150 degree C temperature rise.

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- C. Winding Taps:
  - 1. Transformers 15 KVA and Larger: ANSI/NEMA ST 20.
- D. Sound Levels: ANSI/NEMA ST 20.
- E. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.
- F. Mounting: Transformers shall be suitable for wall mounting.
- G. Coil Conductors: Continuous windings with terminations brazed or welded.
- H. Isolate core and coil from enclosure using vibration- absorbing mounts.
- I. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Set transformer plumb and level.
- B. Use flexible conduit, 2 ft minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.
- C. Provide seismic restraints.

#### 3.2 FIELD QUALITY CONTROL

- A. Check for damage and tight connections prior to energizing transformer.
- B. Measure primary and secondary voltages and make appropriate tap adjustments.

END OF SECTION

SECTION 16470

PANELBOARD

2850

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Lighting and appliance branch circuit panelboard.

1.2 SUBMITTALS

- A. Include outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker arrangement and sizes.

1.3 SPARE PARTS

- A. Keys: Furnish 3 each to Owner.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - PANELBOARDS

- A. General Electric.
- B. Square D.
- C. Westinghouse.

2.3 BRANCH CIRCUIT PANELBOARDS

- A. Lighting and Appliance Branch Circuit Panelboards: NEMA PB1; circuit breaker type.
- B. Enclosure: NEMA PB 1; Type 12.
- C. Provide surface cabinet front with concealed trim clamps, concealed hinge and flush lock all keyed alike. Finish in manufacturer's standard gray.
- D. Provide panelboard with copper bus, ratings as scheduled on Drawings. Provide copper ground bus in all panelboards.
- E. Minimum Integrated Short Circuit Rating: 10,000 amperes rms symmetrical for 240 volt panelboards. Short circuit rating shall not rely on series rated circuit breakers.
- F. Molded Case Circuit Breakers: NEMA AB 1; bolt-on type thermal magnetic trip circuit breakers, with single common trip handle for all poles. Provide circuit breakers UL listed as Type SWD for lighting circuits. Provide UL Class A ground fault interrupter circuit breakers where scheduled on Drawings.

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PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install panelboard plumb in conformance with NEMA PB 1.1.
- B. Height: 6 ft. max at top.
- C. Provide filler plates for unused spaces in panelboards.
- D. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads. Label spares and spaces in pencil or other erasable medium.

3.2 FIELD QUALITY CONTROL

- A. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers, and main conductors.

END OF SECTION

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SECTION 16480

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MOTOR CONTROL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Manual motor starters.
  - 2. Motor control centers.
- B. Related Work In Other Sections:
  - 1. Testing.
  - 2. Housekeeping pads.

1.2 SUBMITTALS

- A. Indicate on shop drawings, front and side views of motor control center enclosures with overall dimensions. Include conduit entrance locations and requirements; nameplate legends; size and number of bus bars per phase, and ground; electrical characteristics including voltage, frame size and trip ratings, withstand ratings, and time-current curves of all equipment and components.
- B. Provide product data on motor starters and combination motor starters, relays, pilot devices, and switching and overcurrent protective devices.
- C. Submit manufacturers' installation instructions.
- D. Operation and Maintenance data: Include spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.3 QUALITY ASSURANCE

- A. Provide devices listed by Underwriter's Laboratories Inc., of heavy-duty and oiltight grade where such rating is applicable, and suitable for installed use and environmental conditions.
- B. Provide devices meeting NEMA standards. Devices meeting only IEC standards are not acceptable.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver in 60 inch 1.2 m maximum width shipping splits, individually wrapped for protection, and mounted on shipping skids.

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- 02902 B. 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.
- C. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to motor control center components, enclosure, and finish.

## PART 2 - PRODUCTS

### 2.1 ACCEPTABLE MANUFACTURERS

- A. Allen-Bradley.
- B. General Electric.
- C. I-T-E/Siemens.
- D. Square D.
- E. Westinghouse.

### 2.2 MANUAL MOTOR STARTERS

- A. Fractional Horsepower Manual Starter: NEMA ICS 2; AC general-purpose Class A manually operated, 1 or 2 pole, full-voltage controller for fractional horsepower induction motors, with thermal overload unit, and toggle operator.
- B. Enclosure: ANSI/NEMA ICS 6; Type 1.

### 2.3 MAGNETIC MOTOR STARTERS

- A. Magnetic Motor Starters: NEMA ICS 2; AC general-purpose Class A magnetic controller for induction motors rated in horsepower.
- B. Full Voltage Starting: Reversing type.
- C. Coil Operating Voltage: 120 volts, 60 Hertz.
- D. Size: NEMA; size as indicated.
- E. Overload Relay: NEMA ICS 2; melting alloy three required for 3-phase.
- F. Combination Motor Starters: Combine motor starters with motor circuit protector disconnect in common enclosure.
- G. Auxillary Contacts: NEMA ICS 2; two closed field convertible contacts in addition to seal-in contact.
- H. Indicating Lights: NEMA ICS 2; transformer push to test with type legend and color as indicated in front cover.

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- I. Control Power Transformers: Provide separate 120 volt control transformer for each starter. Protect transformer with two primary fuses and one secondary fuse. Ground other side of transformer secondary.

#### 2.4 CONTROLLER OVERCURRENT PROTECTION AND DISCONNECTING MEANS

- A. Motor Circuit Protector: FS W-C-375 circuit breakers with integral instantaneous magnetic trip in each pole.

#### 2.5 MOTOR CONTROL CENTER

- A. Motor Control Centers: NEMA ICS 2; Class I, Type B.
- B. Main Overcurrent Protection: Molded case circuit breaker.
- C. Motor Starters: As indicated.
- D. Feeder Tap Units: Molded case thermal-magnetic circuit breakers.
- E. Voltage Rating: 480 volts, 3-phase, 3-wire, 60 Hertz.
- F. Horizontal Bussing: Copper with a continuous current rating as indicated. Include copper ground bus entire length of control center.
- G. Vertical Bussing: NEMA ICS 2; copper.
- H. Integrated Equipment Short Circuit Rating: As indicated. Rating based on series rated breakers not acceptable.
- I. Configuration: Units front mounting only, accessible from the front only.
- J. Enclosure: ANSI/NEMA ICS 6; Type 12.
- K. Finish: Manufacturer's standard gray enamel.
- L. Seismic Requirements: ANSI/IEEE 344; Class I.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install motor control equipment in accordance with manufacturer's instructions.
- B. Select and install heater elements in motor starters to match installed motor characteristics.
- C. Motor Data: Provide neatly typed label inside each motor starter enclosure door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating.

END OF SECTION

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DIVISION 16

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16500 - LUMINAIRES AND LIGHTING

1.1 LUMINAIRES - GENERAL

- A. Provide a new luminaire of the type shown at each location indicated.
- B. Luminaire of similar design, with lens equivalent in construction, light distribution and brightness characteristics, and of equal finish and quality to that shown may be submitted for consideration by indicating such luminaires on the substitution sheet included with the proposal form.
- C. Luminaire complete with lamp and lamp holder, mounting arm, and other components necessary for complete and finished installation when mounted as shown.

1.2 LAMPS

- A. General Electric, Sylvania or Philips with ratings as indicated and suitable for luminaire types utilized.
- B. Install new lamps in all luminaires immediately prior to acceptance by Construction Manager.

1.3 LUMINAIRE MOUNTING

- A. Mount fixtures plumb, level and in alignment. Provide mounting in accordance with the applicable requirements of Section 16100 and as otherwise indicated.
- B. Remove dust and soil marks from luminaires after installation.
- C. Mounting height - as indicated on the drawings.

END OF SECTION

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0889  
SECTION 16721

FIRE ALARM AND SMOKE DETECTION SYSTEMS

2850

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Extension of the existing fire alarm system presently installed in the existing Facility.

B. Related Work In Other Sections:

1. Sprinkler flow switch.
2. PIV flow switch.
3. Tamper switch on PIV.
4. Wiring methods.

1.2 SYSTEM DESCRIPTION AND SCOPE

A. Work to provide the extension of the existing fire alarm system includes, but is not necessarily limited to, the following:

1. All devices, components and wiring to be as manufactured, specified or recommended by manufacturer of the existing system.
2. Provide all required drawings and other information required for proper design, installation, testing and operation of the fire alarm system. At the completion of the work, present "record" issues of the drawings and information to the Owner for record purposes.
4. Contract drawings issued under these specifications showing fire alarm devices, and devices specified in this section of these specifications, are to be considered as "design-basis" drawings and specifications. Fire alarm system vendor shall make changes, additions or deletions in device locations and/or types as required to meet the requirements of these specifications.
5. Incorporate operational functions of the existing fire alarm system into this extension of the existing system so that complete compatibility is obtained. Make all software and hardware changes in the existing system as required.
6. All work shall be in accordance with applicable standards and requirements of NFPA, NEC, UL and of authorities having local jurisdiction.
7. Coordinate with Construction Manager to establish requirements of zoning and coding.

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**PART 2 - PRODUCTS**

**2.1 EQUIPMENT**

- A. Fire Alarm Station: Suitable for semi-flush mounting in finished areas and surface mounting in unfinished areas.
- B. Horn: Suitable for semi-flush mounting in finished areas and surface mounting in unfinished areas.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. Install system in accordance with manufacturer's instructions.
- B. Make conduit and wiring connections to sprinkler flow switches, and sprinkler valve tamper switches, furnished and installed by others.

**3.2 FIELD QUALITY CONTROL**

- A. Test in accordance with applicable standards, requirements of local authorities having jurisdiction, and other requirements hereinbefore specified.

**3.3 FIRE ALARM WIRE AND CABLE COLOR CODE**

- A. Provide fire alarm circuit conductors with color coded insulation to match existing.
- B. Where consistent with the specified standards and regulations and the rating and marking of cables, the fire alarm system wiring is permitted to be run in the ceiling air handling plenum without conduit. In addition, if cable is rated and marked for cable tray usage, the cable may be installed in the cable tray system.

**END OF SECTION**

SECTION 16850  
ELECTRICAL HEAT TRACING

2850

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Section Includes:

1. Provide all labor, materials, installation equipment and tools, and do all work necessary for the complete design and installation of the electric heat tracing system.

B. Related Work in Other Sections:

1. Piping.
2. Insulation.
3. Electrical power for heat tracing systems including electrical wiring from panelboards to thermostats.

1.2 DESCRIPTIONS

1. Provide complete electric heat tracing systems for heating of piping as indicated on the drawings.
2. Systems to be completely designed by the manufacturer, Thermon, Raychem, or approved equal. Basis of design Raychem Chemelex BTU.
3. Systems to be designed using criteria of surface area or pipe size, insulation, minimum fluid temperature of plus 45F and minimum outdoor ambient temperature of minus 20F, and wind velocity of zero mph.
4. All components are to be UL listed.

1.3 SUBMITTALS

- A. Provide shop drawings for review prior to construction, and "record" drawings and manuals for record at completion of the project. See reference to standard requirements for FEMP suppliers.
- B. Provide electrical design data showing proper circuit breaker size required for each heat tracing circuit provided under these specifications.
- C. Refer to Section 01100 for additional information and requirements regarding submittals.

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**PART 2 - PRODUCTS**

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**2.1 MATERIALS**

- A. Heat Tracing Cables: Self-limiting, parallel circuit type, with ground braid and polyolefin jacket, designed for operation with service voltage of 120 volts, 60 hz, with rating as required to satisfy criteria specified. Basis of Design: Chemelex BTU cable.
- B. Thermostats: Ambient sensing type, and located where sensing is not influenced by radiation off heated surfaces.

**PART 3 - EXECUTION**

**3.1 GENERAL**

- A. Installation to be in accordance with contract drawings and manufacturer's recommendations.
- B. After application of thermal insulation, provide warning labels on all heat-traced piping at each end and at 20 foot maximum intervals, or closer in complex areas. Basis of Design: Raychem type ETL markers.

**3.2 TESTING**

- A. Make electrical, short-circuit, ground and insulation resistance tests of the systems before and after application of the pipe insulation, in accordance with the manufacturer's recommendations. Submit a copy of test readings to the Construction Manager for review.

END OF SECTION

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APPENDIX A - EQUIPMENT COORDINATION SCHEDULE

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EQUIPMENT COORDINATION SCHEDULE  
-----

THE FOLLOWING CODES ARE USED IN THE HEADINGS FOR EACH SHEET -

ITEM	EQUIPMENT TYPE AND DESIGNATION
-----	-----
QU	QUANTITY OF IDENTICAL ITEMS
VOLTS	VOLTAGE & PHASE
	PHASE DESIGNATIONS TO BE AS FOLLOWS -
	1 PHASE UNITS REQUIRING 2 WIRE SERVICE USE 1
	1 PHASE UNITS REQUIRING 3 WIRE SERVICE USE 2
	3 PHASE UNITS REQUIRING 3 WIRE SERVICE USE 3
	3 PHASE UNITS REQUIRING 4 WIRE SERVICE USE 4
HP/KW/A	HORSEPOWER OF MOTOR, UNLESS INDICATED K FOR KW, A FOR AMPERES
F	FURNISHED UNDER DIVISION OR SECTION INDICATED
I	INSTALLED UNDER DIVISION OR SECTION INDICATED
W	WIRED UNDER DIVISION OR SECTION INDICATED
STARTER	INCLUDES CONTACTOR FOR HEATER

THE TERM "WIRED UNDER" SIGNIFIES CONNECTION BETWEEN THE LINE SIDE OF THE DEVICE (EQUIPMENT, DISCONNECT, STARTER, OR CONTROL), AND THE LOAD SIDE OF THE PRECEDING DEVICE.

CONTROL TYPE  
-----

DM	DAMPER MOTOR
INT	INTERLOCKED
LIC	LEVEL INDICATOR CONTROLLER LIC-109
LOR	LOCAL-OFF-REMOTE SELECTOR SWITCH
SSW	OFF-AUTOMATIC SELECTOR SWITCH
SS/PLG	START & STOP PUSHBUTTON W/ GREEN PILOT LIGHT
SPCL	SPECIAL CONTROL - SEE EQUIP. SPEC.
TS	TEMPERATURE SWITCH
TT	MOTOR WINDING TEMPERATURE SENSOR RELAY

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DISCONNECT  
 -----

LOCATION  
 -----

P AND R - PLUG ON EQUIPMENT  
 RECEPTACLE SHOWN ON ELECT DWGS

DWG	REFER TO DRAWINGS
MCC	MOTOR CONTROL CENTER
N	NONE
PNL	PANELBOARD
SWRB	STORM WATER RETENTION BASIN VALVE HOUSE
TPCP	TRANSFER PUMP CONTROL PANEL 18 X 100 CLB
U	AT OR NEAR UNIT

STARTER TYPE  
 -----

SPECIFICATION DIVISION OR SECTION UNDER  
 WHICH THE WORK IS TO BE PERFORMED  
 -----

MAN            MANUAL  
 FVNR        MAGNETIC FULL VOLTAGE  
              NON REVERSING

E INCLUDED IN WORK UNDER DIVISION 16  
 (ELECTRICAL)  
 H INCLUDED IN WORK UNDER SECTION 15500  
 (HV)  
 I INCLUDED IN WORK UNDER SECTION 15945  
 (INSTRUMENTATION)  
 P INCLUDED IN WORK UNDER SECTION 15942  
 (PIPING AND ASSOCIATED EQUIPMENT)

ITEM	EQUIPMENT				DISCONNECT		STARTER			CONTROL			
	QU	HP/KW/A	VOLTS	FIW	LOCATION	FIW	LOCATION	TYPE	FIW	V	LOCATION	TYPE	FIW
18X100MTR SWRB TRANSFER PUMP	1	88.	460-3	PPE	MCC-SWRB	EEE	MCC-SWRB	FVNR	EEE	120	TPCF	SS/PLG LOR INT/LIC TT(2)	III III IIE PIE
18X101MTR SWRB TRANSFER PUMP	1	88.	460-3	PPE	MCC-SWRB	EEE	MCC-SWRB	FVNR	EEE	120	TPCF	SS/PLG LOR INT/LIC TT(2)	III III IIE PIE
18X100HTR ELEC UNIT HEATER	1	2.5KW	240-1	HHE	PNL	EEE	U	SPCL	PPP	U		TS	HHH
18X101HTR ELEC UNIT HEATER	1	2.5KW	240-1	HHE	PNL	EEE	U	SPCL	PPP	U		TS	HHH
18X100FAN EXH FAN	1	1/4	120-1	HHH	U	HHE	N			120	DWG DWG DWG	TS DM SSW	HEE HHE HEE
18X100CLB SWRB TRANSFER PUMP CONTROL PANEL	1	8A	120-1	IIE	PNL	EEE	N					SPCL	IIE
18X100SMP REFRIG. SAMPLER COMPART.	1	1.0 A	120-1	IIE	P&R	EEE	N						

ITEM	EQUIPMENT				DISCONNECT		STARTER			CONTROL			
	QU	HP/KW/A	VOLTS	FIW	LOCATION	FIW	LOCATION	TYPE	FIW	V	LOCATION	TYPE	FIW
18X101CLR COMPOSITE SAMPLER CNTRL PNL	1	.03K	120-1	IIE	PNL	EEE	N						
18X103PMP SAMPLE PUMP	1	1/6	120-1	PPE	PNL	EEE	U	MAN	EEE				
HEAT TRAC	1	.5K	120-1	EEE	PNL	EEE	N			120	U	TS	EEE

2850

APPENDIX B - EQUIPMENT SPECIFICATIONS

<u>DESCRIPTION</u>	<u>REV. NO.</u>	<u>DATE</u>
Centrifugal Pump Specification SWRB Transfer Pumps	0	12-20-91
Centrifugal Pump Specification Composite Sample Pump	0	12-20-91

234

CENTRIFUGAL PUMP SPECIFICATION				No.	BY	DATE	ITEMS REVISED	SHEET   OF	
								SPEC. No. 02902-4502	REV. 0
								FILE No.	DATE 12-20-91
CLIENT	DOE/WMCO	EQUIP. No.						P.O. No.	
SITE	FEMP FERNALD, OHIO	18-X100-PMP						BY	CKD.
EQUIP. NAME	SWRB TRANSFER PUMPS	18-X101-PMP						JCW	FWB
								APPR.	
1	INFORMATION			48	HYDRAULIC DATA				
2	TYPE/SIZE	SUBMERSIBLE WASTEWATER PUMP		49	NORMAL FLOW	860		GPM	
3		NO. REQ'D.		50	RATED FLOW	1000		GPM	
4	LIQUID PUMPED	STORMWATER		51	MIN. FLOW REQ'D.	700		GPM	
5	SOLIDS/DESCRIPTION	% /		52	SUCTION PRESSURE	—		PSIA	
6	CORROSIVE COMPOUNDS	—		53	NPSH AVAILABLE	12		FT.	
7	OPERATING TEMPERATURE	40-110° F		54	NPSH REQUIRED	—		FT.	
8	SPECIFIC GRAVITY/VISCOSITY	1.0 / 1.14 CP		55	TDH REQUIRED	120		FT.	
9	VAPOR PRESSURE	14.95 PSIA		56	BHP: RATED/MAX.	58 / 72			
10	MANUFACTURER	FLIGHT OR APPROVED EQUAL		57	CURVE NO.	EFF. 60		%	
11	MODEL NO	CP-3300		58	IMP. DIA.: RATED/MAX.	/ 466		IN.	
12				59					
13				60					
14	CONSTRUCTION			61	MATERIALS				
15	NO. STAGES	SINGLE		62	CASING	CAST IRON			
16	BEARINGS:	<input checked="" type="checkbox"/> OIL <input type="checkbox"/> OILMIST <input type="checkbox"/> GREASE <input checked="" type="checkbox"/> SEALED FOR LIFE		63	IMPELLER	CAST IRON			
17	COOLING:	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO		64	WEAR RINGS	NITRILE COATED STEEL			
18	BASE SIZE	TYPE		65	SHAFT/SLEEVE	CARBON STEEL			
19	STILTS:	<input type="checkbox"/> YES <input type="checkbox"/> NO		66	GLAND				
20	COUPLING: MFR.	SIZE		67	COLUMN				
21	<input type="checkbox"/> SPACER	<input type="checkbox"/> NON-SPACER		68	GASKETS				
22	STUFFING BOX COVER			69	BASEPLATE				
23	<input type="checkbox"/> STD.	<input type="checkbox"/> JACKETED <input type="checkbox"/> SEAL ONLY		70	COUPLING GUARD				
24	PACKING TYPE			71	OTHER				
25	LANTERN RINGS	<input type="checkbox"/> YES <input type="checkbox"/> NO		72					
26	MECHANICAL SEAL	MFG STD		73	CONNECTIONS				
27	MFR. & TYPE	TUNGSTEN & CARBIDE		74		SIZE	RATING	LOCATION	
28	<input type="checkbox"/> BALANCED	<input type="checkbox"/> UNBALANCED <input type="checkbox"/> INSIDE		75	SUCTION				
29	<input type="checkbox"/> OUTSIDE	<input type="checkbox"/> SINGLE <input type="checkbox"/> DOUBLE		76	DISCHARGE	8"	125 LB		
30	<input type="checkbox"/> BACK TO BACK	<input type="checkbox"/> TANDEM <input type="checkbox"/> FACE TO FACE		77	<input type="checkbox"/> VENT	<input type="checkbox"/> DRAIN		<input type="checkbox"/> GAGE	
31	FLUSH	<input checked="" type="checkbox"/> INTERNAL <input type="checkbox"/> EXTERNAL		78					
32	<input type="checkbox"/> SEAL COOLING/QUENCH (SEE REMARKS)			79	DRIVER				
33	VERTICAL PUMP			80	<input checked="" type="checkbox"/> MOTOR	<input type="checkbox"/> TURBINE		<input type="checkbox"/> OTHER	
34	MTG. PLATE REQ'D.	SIZE		81	TYPE & ENCLOSURE	INDUCTION/TEFC			
35	COLUMN HGT.	<input type="checkbox"/> SUCTION STRAINER		82	HP/RPM	88 / 1770		FRAME	
36	<input type="checkbox"/> FLOAT SWITCH - ENCLOSURE			83	PH/HZ/VOLTS	3 / 60 / 460		MFR.	
37				84	<input type="checkbox"/> NON-OVERLOAD	S.F. 1.0			
38				85	SPECIAL				
39									
40	REMARKS: PROVIDE AUTOMATIC DISCHARGE CONNECTION ELBOW AND								
41	UPPER & LOWER GUIDE BRACKET ASSEMBLE								
42	PROVIDE WITH FACTORY INSTALLED POWER & SENSOR								
43	CABLE (MIN. LENGTH 50')								
44	PROVIDE THERMAL SWITCHES AND MONITORING UNIT TO MONITOR								
45	TEMPERATURE IN EACH PHASE OF THE MOTOR WINDINGS.								
46	PROVIDE LEAKAGE SENSORS AND MONITORING UNIT FOR MOTOR HOUSING.								
47	* VENDOR TO SUPPLY OR VERIFY THIS INFORMATION WITH QUOTATION								

# CENTRIFUGAL PUMP SPECIFICATION

No.	BY	DATE	ITEMS REVISED	SHEET 1 OF 2850	SPEC. No. 02902-4502	REV. 0
					FILE No.	DATE 12-20-91
					P.O. No.	
					BY JCW	CKD. FWB
						APPR.

CLIENT DOE/WMCO	EQUIP. No. 18-X102-PMP
SITE FEMP FERNALD, OHIO	
EQUIP. NAME COMPOSITE SAMPLE PUMP	

1	INFORMATION	48	HYDRAULIC DATA
2	TYPE/SIZE <b>INLINE/ 1/2"</b>	49	NORMAL FLOW <span style="float: right;">20 GPM</span>
3		50	RATED FLOW <span style="float: right;">22 GPM</span>
4	LIQUID PUMPED <b>GROUNDWATER</b>	51	MIN. FLOW REQ'D. <span style="float: right;">15 GPM</span>
5	SOLIDS/DESCRIPTION % /	52	SUCTION PRESSURE <span style="float: right;">PSIA</span>
6	CORROSIVE COMPOUNDS	53	NPSH AVAILABLE <span style="float: right;">FT.</span>
7	OPERATING TEMPERATURE <b>55-102° F</b>	54	NPSH REQUIRED <span style="float: right;">FT.</span>
8	SPECIFIC GRAVITY/VISCOSITY <b>1.0 / 1.14 CP</b>	55	TDH REQUIRED <span style="float: right;">10 FT.</span>
9	VAPOR PRESSURE <span style="float: right;">PSIA</span>	56	BHP: RATED/MAX. <span style="float: right;">/</span>
10	MANUFACTURER <b>BELL &amp; GOSSETT OR APPROVED EQUAL</b>	57	CURVE NO. <span style="float: right;">EFF. %</span>
11	MODEL <b>HV 1/2"</b>	58	IMP. DIA.: RATED/MAX. <span style="float: right;">/ IN.</span>
12		59	
13		60	
14	CONSTRUCTION	61	MATERIALS
15	NO. STAGES <b>SINGLE</b>	62	CASING <b>BRONZE</b>
16	BEARINGS: <input checked="" type="checkbox"/> OIL <input type="checkbox"/> OILMIST <input type="checkbox"/> GREASE <input type="checkbox"/> SEALED FOR LIFE	63	IMPELLER <b>BRASS</b>
17	COOLING: <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO <span style="float: right;">GPM</span>	64	WEAR RINGS
18	BASE SIZE <span style="float: right;">TYPE</span>	65	SHAFT/SLEEVE <b>CARBON STEEL</b>
19	STILTS: <input type="checkbox"/> YES <input type="checkbox"/> NO	66	GLAND
20	COUPLING: MFR. <span style="float: right;">SIZE</span>	67	COLUMN
21	<input type="checkbox"/> SPACER <input type="checkbox"/> NON-SPACER	68	GASKETS
22	STUFFING BOX COVER	69	BASEPLATE
23	<input type="checkbox"/> STD. <input type="checkbox"/> JACKETED <input type="checkbox"/> SEAL ONLY	70	COUPLING GUARD
24	PACKING TYPE	71	OTHER
25	LANTERN RINGS <input type="checkbox"/> YES <input type="checkbox"/> NO	72	
26	MECHANICAL SEAL <b>MFG. STD.</b>	73	CONNECTIONS
27	MFR. & TYPE <span style="float: right;">CODE</span>	74	SIZE <span style="float: right;">RATING</span> <span style="float: right;">LOCATION</span>
28	<input type="checkbox"/> BALANCED <input type="checkbox"/> UNBALANCED <input type="checkbox"/> INSIDE	75	SUCTION <b>1/2"</b> <span style="float: right;">125 PSI</span>
29	<input type="checkbox"/> OUTSIDE <input type="checkbox"/> SINGLE <input type="checkbox"/> DOUBLE	76	DISCHARGE <b>1/2"</b> <span style="float: right;">125 PSI</span>
30	<input type="checkbox"/> BACK TO BACK <input type="checkbox"/> TANDEM <input type="checkbox"/> FACE TO FACE	77	<input type="checkbox"/> VENT <input type="checkbox"/> DRAIN <input type="checkbox"/> GAGE
31	FLUSH <input type="checkbox"/> INTERNAL <input type="checkbox"/> EXTERNAL	78	
32	<input type="checkbox"/> SEAL COOLING/QUENCH (SEE REMARKS)	79	DRIVER
33	VERTICAL PUMP	80	<input checked="" type="checkbox"/> MOTOR <input type="checkbox"/> TURBINE <input type="checkbox"/> OTHER
34	MTG. PLATE REQ'D. <span style="float: right;">SIZE</span>	81	TYPE & ENCLOSURE
35	COLUMN HGT. <input type="checkbox"/> SUCTION STRAINER	82	HP/RPM <b>1/6 / 1750</b> <span style="float: right;">FRAME</span>
36	<input type="checkbox"/> FLOAT SWITCH - ENCLOSURE	83	PH/HZ/VOLTS <b>1 / 60 / 120</b> <span style="float: right;">MFR.</span>
37		84	<input type="checkbox"/> NON-OVERLOAD <span style="float: right;">S.F.</span>
38		85	SPECIAL <b>MOTOR TO HAVE BUILT-IN THERMAL OVERLOAD PROTECTORS</b>
39			
40	REMARKS:		
41			
42			
43			
44			
45			
46			236
47	* VENDOR TO SUPPLY OR VERIFY THIS INFORMATION WITH QUOTATION		

APPENDIX C - PIPING SPECIFICATIONS

<u>SPECIFICATION NO.</u>	<u>REV.</u>	<u>DATE</u>	<u>NO. OF PAGES</u>
4502-60-02	A	1-15-92	3

## PIPING MATERIAL SPECIFICATION

4502 - 60 -02

Page 1 of 3

SERVICE: Above Ground and Inside of Building - Treated Water (TWX2), Groundwater (GW2) Contaminated effluent (CE2)

PRIMARY FLANGE RATING &amp; FACING: 150 PSI FF

CORROSION ALLOWANCE: .0

MAX. TEMP: 110 Degree F

BASIC MATERIAL: CARBON STEEL

ITEM	SIZE		MATERIAL OR MANUFACTURER	NOTE
	FROM	THROUGH RATING AND TYPE		
PIPE	1/2"	1 1/2"	Sch. 40, Seamless	ASTM A106-B
	2"	12"	Sch. 40, ERW, 85% J.F.	ASTM A53-B
FITTINGS	1/2"	1 1/2"	3000 Pound Threaded,	ASTM A 105
	2"	20"	Sch. 40	ASTM A 234-WPB
FLANGE	1/2"	1 1/2"	Class 150 FF Threaded	ASTM A105
	2"	20"	Class 150 FF Weldneck Std. Wt.	ASTM A105
	1/2"	20"	Class 150 FF Blind	ASTM A105
	2"	20"	Class 150 Lap Joint	ASTM A105
ORIFICE FLANGES	2"	12"	Class 300 RF Weldneck W/ 1/2" SCR.D. Taps Std. Wt.	ASTM A105
STUB END	2"	20"	Std. Wt. Stub End ASA Length Type A B.E.	ASTM A234
NIPPLE	1/2"	1 1/2"	Sch. 40 TBE Seamless	ASTM A106-B
UNION	1/2"	1 1/2"	3000 Pound, Screwed, Brass Seats	ASTM A105
PLUG	1/2"	1 1/2"	Round Head Plug Threaded	ASTM A105
SWAGE	1/2"	1 1/2"	Sch. 40 TBE Ecc. Swage	ASTM A234-WPB
	1/2"	1 1/2"	SCH. 40 BLE/TSE	ASTM A234-WPB
			Ecc. Swage	66
	1/2"	1 1/2"	Sch. 40 TBE Swage	ASTM A234-WPB
	1/2"	1 1/2"	SCH. 40 BLE/TSE	ASTM A234-WPB
			Swage	66
REDUCER	2"	20"	Sch. 40 ECC. Reducer	ASTM A234-WPB
	2"	20"	SCH. 40 Reducer	ASTM A234-WPB

5. Use for mating equipment. Use unions normally.  
64. Use when large end is 1 1/2 inch or smaller.  
46. Use when small end is 1 1/2 inch or smaller.  
66. Use when large end is greater than 2 inch.  
67. All material by the Subcontractor.

PIPING MATERIAL SPECIFICATION

4502 - 60 -02

Page 2 of 3

SERVICE: Above Ground and Inside of Building - Treated Water (TWX2), Groundwater (GW2) Contaminated effluent (CE2)

PRIMARY FLANGE RATING &amp; FACING: 150 PSI FF

CORROSION ALLOWANCE: .0

MAX. TEMP: 110 Degree F

BASIC MATERIAL: CARBON STEEL

ITEM	SIZE		MATERIAL OR MANUFACTURER	NOTE	
	FROM	THROUGH RATING AND TYPE			
BRANCH CONN	1/2"	1 1/2"	3000 Pound Threadolet	ASTM A105	10,5
	1/2"	1 1/2"	3000 Pound TEE Threaded	ASTM A105	57
	2"	20"	Sch. 40 TEE B.E.	ASTM A234-WPB	57
	1"		3000 Pound Threaded Elbolet	ASTM A105	9
	1"		3000 POUND Threaded Latrolet	ASTM A105	9
LINE BLINDS	1"	20"	Class 150 Spec Blind	ASTM A516 GR. 70	
	1"	20"	Class 150 Plain Blind	ASTM A516 GR. 70	
STRAINER	2"	20"	125 Pound Screwed Y-Strainer, 20 Mesh SS Screen	Cast Iron, Mueller Y-Pattern	
GASKET	1/2"	20"	Class 150 FF 1/16" thick.	Compressed, Non Asbestos, or approved equal	
	2"	12"	Class 300 RF 1/16" thick.	Compressed, Non Asbestos, or approved equal	
BOLTING	1/2"	20"	Class 150 FF Machine Bolt and Nut, Heavy Hex Head	ASTM A307-B, A194 GR2E, Cadmium Plated	
HOSE CONN	3/4"			Powell Fig.527 or approved equal	
<u>VALVES</u>					
GATE	3/4"		Class 150, Screwed, Bronze body and Bonnet, Rising Stem	Powell Fig. 2714 or approved equal	
	2"		Class 125 FF Solid Wedge, Cast Iron Body and Bonnet, outside Screw, Rising Stem	Powell Fig. 1793 or approved equal	

- 
10. Use for hydrostatic vents, drains and thermowells.  
57. Refer to branch reinforcement chart when to use.  
9. Use for thermowells.  
1. Use for vents, drains and instr. conn.  
4. Use in horizontal lines and vertical upward flow only.  
67. All material by the Subcontractor.

PIPING MATERIAL SPECIFICATION

4502 - 60 -02

Page 3 of 3

SERVICE: Above Ground and Inside of Building - Treated Water (TWX2), Groundwater (GW2) Contaminated effluent (CE2)

PRIMARY FLANGE RATING &amp; FACING: 150 FF

CORROSION ALLOWANCE: .0

MAX. TEMP: 110 Degree F

BASIC MATERIAL: CARBON STEEL

ITEM	SIZE		MATERIAL OR MANUFACTURER	NOTE
	FROM	THROUGH RATING AND TYPE		
CHECK	1/2"	1 1/2"	Class 200 Screwed, Bronze Body, Swing Check	Crane Fig. 36, or approved equal
	2"	20"	Class 125 Pound Globe FF Cast Iron Body, Bronze Disc	Mueller #105M-AP, or approved Equal 4
BUTTERFLY	2"	6"	Class 150 FF, Lug Type, Ductile Iron body, Buna-N Liner Lever Operated lockable Handle	Demco Series NE 5114311, or approval equal
	8"	12"	Class 150, Lug type, ductile Iron body, Buna-N Liner, Gear Operator	Demco Series, NE5124319, or approved equal.
	14"	20"	Class 150, Lug type, ductile Iron body, Buna-N Liner, Gear Operator	Demco Series, NF5124319, or approved equal.
BALL	1/2"	1 1/2"	600 psig WOG, Bronze Body, with Padlockable Lever handle	Appollo, No. 75-100 or approved equal

4. Use in horizontal lines and vertical upward flow only.  
67. All material by the Subcontractor.

APPENDIX D - INSTRUMENTATION

<u>I.D. NO.</u>	<u>DESCRIPTION</u>	<u>REV.</u>	<u>DATE</u>	<u>NO. OF PAGES</u>
	Instrument Index	0	12-20-91	8
11-01	Venturi Flowmeter	0	12-20-91	1
21-01	Vortex Flowmeter	0	12-20-91	1
21-02	Differential Pressure Transmitter	0	12-20-91	1
22-01	Level Instruments (Capacitance Type)	0	12-20-91	1
22-02	Not Used			
52-01	Not Used			
53-01	Pressure Gauges	A	12-20-91	1
53-02	Not Used			
61-01	Flow Totalizer Indicator	0	12-20-91	1
61-02	Flow Totalizer Indicator	0	12-20-91	1
61-03	Flow Totalizer Indicator	0	12-20-91	1
61-04	Flow Totalizer Indicator	0	12-20-91	1
62-01	Digital Indicating Controller	0	12-20-91	1
62-02	Digital Indicating Controller	0	12-20-91	1
63-01	Flow Totalizer Recorder	0	12-20-91	1
63-02	Not Used			
77-01	Motorized On-Off Valves	0	12-20-91	1

78-01	Motorized Throttling Valves	0	12-20-91	1
84-01	Temperature Switches	0	12-20-91	1
99-01	Composite Sampling System	0	12-20-91	2

THE FOLLOWING PRODUCT CODE IS USED AS A PREFIX IN SPECIFICATION SHEET NUMBERS. SHEETS ARE NUMBERED CONSECUTIVELY WITHIN EACH CODE SECTION. ENTER THIS SPEC NO IN THE 'SPEC NO.' COLUMN.

PRIMARY ELEMENTS-----

- 11 FLOW PRIMARY DEVICES
- 12 LEVEL PRIMARY DEVICES
- 13 PRESSURE PRIMARY DEVICES
- 14 TEMPERATURE MEASURING DEVICES/WELLS
- 15 LIQUID ANALYSIS DEVICES
- 16 GAS ANALYSIS DEVICES
- 17 MISCELLANEOUS PRIMARY ELEMENTS

TRANSMITTERS/FIELD DEVICES-----

- 21 FLOW TRANSMITTERS
- 22 LEVEL TRANSMITTERS
- 23 PRESSURE TRANSMITTERS
- 24 TEMPERATURE TRANSMITTERS
- 25 DIFFERENTIAL PRESSURE TRANSMITTERS
- 26 PNEUMATIC FIELD TRANSDUCERS
- 27 ELECTRICAL FIELD TRANSDUCERS
- 28 MISCELLANEOUS TRANSMITTERS

SAFETY DEVICES-----

- 31 PRESSURE SAFETY/RELIEF VALVES
- 32 RUPTURE DISCS
- 33 FLAME ARRESTERS
- 34 CONSERVATION VENTS
- 35 MISCELLANEOUS SAFETY DEVICES

FIELD CONTROLLERS/DEVICES-----

- 41 FLOW CONTROLLERS
- 42 LEVEL CONTROLLERS
- 43 PRESSURE CONTROLLERS
- 44 TEMPERATURE CONTROLLERS
- 45 MISCELLANEOUS CONTROLLERS

FIELD INDICATORS-----

- 51 FLOW INDICATORS
- 52 LEVEL INDICATORS
- 53 PRESSURE INDICATORS
- 54 TEMPERATURE INDICATORS
- 55 MISCELLANEOUS INDICATORS

PANEL MOUNTED DEVICES-----

- 61 INDICATORS
- 62 INDICATING CONTROLLERS
- 63 RECORDERS
- 64 RECORDING CONTROLLERS
- 65 MISC FRONT MOUNTED DEVICES
- 66 MISC REAR MOUNTED DEVICES
- 67 ANNUNCIATORS
- 68 MISCELLANEOUS PANEL DEVICES

VALVES-----

- 71 PRESSURE CONTROL VALVE
- 72 THROTTLING VALVES
- 73 ON-OFF VALVES
- 74 HAND VALVES
- 75 SOLENOID VALVES
- 76 INSTRUMENT VALVES
- 77 MISCELLANEOUS VALVES

SWITCHES-----

- 81 FLOW SWITCHES
- 82 LEVEL SWITCHES
- 83 PRESSURE SWITCHES
- 84 TEMPERATURE SWITCHES
- 85 ELECTRICAL SWITCHES/DEVICES
- 86 MISCELLANEOUS SWITCHES

MISCELLANEOUS SYSTEMS-----

- 91 CONTROL PANELS
- 92 WEIGH SYSTEMS
- 93 PROGRAMMABLE CONTROL SYSTEMS
- 94 MISCELLANEOUS ANALOG DEVICES
- 95 MISCELLANEOUS DIGITAL DEVICES
- 96 MISCELLANEOUS DEVICES
- 97 MISC ANALOG CONTROL SYSTEMS
- 98 MISC DIGITAL CONTROL SYSTEMS
- 99 MISCELLANEOUS SYSTEMS

THE FOLLOWING CODES OR ABBREVIATIONS ARE USED UNDER THE PAGE HEADINGS NOTED -  
'P&ID NO.' COLUMN

THE DRAWING NUMBER SHOWN IN THIS COLUMN REFERS TO THE PIPING AND  
INSTRUMENT DRAWING ON WHICH THIS INSTRUMENT IS SHOWN.

'LOC' COLUMN (INDICATES LOCATION OF INSTRUMENT)

F	- FIELD MOUNTED (NOT ON OR IN A PANEL/ENCLOSURE)
CC	- COMMUNICATIONS CENTER IN BLDG 53
18-X104-CLR	- SWRB CONTROL PANEL
18-X101-CLR	- COMPOSITE SAMPLE SYSTEM CONTROL PANEL
MCC	- MOTOR CONTROL CENTER

'SPEC NO.' COLUMN

THE SPECIFICATION NUMBER IN THIS COLUMN REFERS TO THE HARDWARE  
SPECIFICATION SHEET NUMBER THAT THIS INSTRUMENT APPEARS ON. (SEE  
PREVIOUS PAGE AND BELOW)

EQUIP	- DEVICE IS FURNISHED WITH EQUIPMENT PACKAGE SPECIFIED IN APPENDIX B - EQUIPMENT AND PIPING SPECIFICATIONS
PNL	- FURNISHED BY PANEL VENDOR
ELEC	- SPECIFIED ON ELEC. DWG.

"SIGNAL" INPUT/OUTPUT COLUMN

INPUT OR OUTPUT RANGE OVER WHICH THE INSTRUMENT OPERATES.  
EXAMPLE: 4 - 20 ma dc.

'CHART OR SCALE' COLUMN

INSTRUMENT INDICATION. EXAMPLE: 50 - 100 DEG. C

"IN STL. DETAIL" COLUMN

THE NUMBER SHOWN IN THIS COLUMN REFERS TO THE INSTRUMENT  
INSTALLATION DETAIL DWG. OR I.D. NO.

"LOOP DIAG." COLUMN

THE NUMBER SHOWN IN THIS COLUMN REFERS TO THE INSTRUMENT LOOP DIAG.  
DWG. NO.

'POWER' COLUMN

POWER SUPPLY VOLTAGE

INSTRUMENT INDEXSPEC. 2902-4502  
CFC ISSUE

<u>TAG NO</u>	<u>SERVICE</u>	<u>DESCRIPTION</u>	<u>LOC</u>	<u>P&amp;ID</u>	<u>LOOP SCHM</u>	<u>INST DET</u>	<u>SPEC</u>	<u>SIGNAL</u>	<u>POWER</u>
LI-101	NOT USED								
LSH-102	NOT USED								
LSL-102	NOT USED								
LIC-103	NOT USED								
LT-103	NOT USED								
LSH-103	NOT USED								
LSL-103	NOT USED								
LA-103	NOT USED								
DPS-104	NOT USED								
DPS-105	NOT USED								
DPS-106	NOT USED								
DPS-107	NOT USED								
FE-108	GROUNDWATER TO MH-176B	FLOW VENTURI	F	P-2	I-3	P-5	11-01	0-250"WC	-
FT-108	GROUNDWATER TO MH-176B	FLOW TRANSMITTER	F	P-2	I-3	01	21-03	4-20MA	LOOP
FQR-108/ FI-108/ FQI-108	GROUNDWATER TO MH-176B	FLOW RECORDER	18-X100 -CLR	P-2	I-3	I-4	63-01	4-20MA	120VAC

<u>TAG NO</u>	<u>SERVICE</u>	<u>DESCRIPTION</u>	<u>LOC</u>	<u>P&amp;ID</u>	<u>LOOP SCHM</u>	<u>INST DET</u>	<u>SPEC</u>	<u>SIGNAL</u>	<u>POWER</u>
LAH-109	SWRB LEVEL CONTROL	HIGH LEVEL ALARM (PNL LIGHT)	18X-100 -CLR	P-2	I-3	I-4	PNL	120VAC	120VAC
LAL-109	SWRB LEVEL CONTROL	LOW LEVEL ALARM (PNL LIGHT)	18X-100 -CLR	P-2	I-3	I-4	PNL	120VAC	120VAC
LIC-109	SWRB LEVEL CONTROL	PANEL MTD LEVEL CONTROLLER	18-X100 -CLR	P-2	I-3	I-4	62-01	4-20MA	120VAC
LT-109	SWRB LEVEL CONTROL	CAPACITANCE LEVEL TRANSMITTER	F	P-2	I-3	01	22-01	4-20MA	120VAC
LV-109	SWRB LEVEL CONTROL	ELEC FLOW CONTROL VALVE	F	P-2	I-3	P-5	78-01	4-20MA	120VAC
PI-110	SWRB TRANS STATION DISCH PRESS	PRESSURE INDICATOR	F	P-2	-	P-6	53-01	-	-
FQI-111/ FI-111	SWRB TRANS STATION FLOW	INDICATING FLOW TOTALIZER	18-X100 -CLR	P-2	I-3	I-4	61-01	4-20MA	120VAC
FT-111	SWRB TRANS STATION FLOW	VORTEX FLOW TRANSMITTER	F	P-2	I-3	01	21-01	4-20MA	LOOP
FQI-112/ FI-112	SWRB TRANS STATION FLOW TO EXIST FORCE MAIN	INDICATING FLOW INTEGRATOR	18-X100 -CLR	P-2	I-3	I-4	61-02	4-20MA	120VAC
FT-112	SWRB TRANS STATION FLOW TO EXIST FORCE MAIN	VORTEX FLOW TRANSMITTER	F	P-2	I-3	01	21-01	4-20MA	LOOP
FQI-113/ FI-113	SWRB TRANS STATION FLOW TO SO PLUME FORCE MAIN	INDICATING FLOW INTEGRATOR	18-X100 -CLR	P-2	I-3	I-4	61-03	4-20MA	120VAC

<u>TAG NO</u>	<u>SERVICE</u>	<u>DESCRIPTION</u>	<u>LOC</u>	<u>P&amp;ID</u>	<u>LOOP SCHM</u>	<u>INST DET</u>	<u>SPEC</u>	<u>SIGNAL</u>	<u>POWER</u>
FT-113	SWRB TRANS STATION FLOW TO SO PLUME FORCE MAIN	VORTEX FLOW TRANSMITTER	F	P-2	I-3	01	21-01	4-20MA	LOOP
TE-114	SWRB TRANS PMP MTR TEMP	TEMPERATURE SENSOR	F	P-2	I-3	-	EQUIP	-	24VAC
TS-114	SWRB TRANS PMP MTR TEMP	TEMPERATURE SWITCH	18-X100 -CLR	P-2	I-3	I-4	EQUIP	-	24VAC
TAH-114	SWRB TRANS PMP MTR TEMP	TEMPERATURE SWITCH	18-X100 -CLR	P-2	I-3	I-4	EQUIP	-	24VAC
TE-115	SWRB TRANS PMP MTR TEMP	TEMPERATURE SENSOR	F	P-2	I-3	-	EQUIP	-	24VAC
TS-115	SWRB TRANS PMP MTR TEMP	TEMPERATURE SWITCH	18-X100 -CLR	P-2	I-3	I-4	EQUIP	-	24VAC
FV-117	SO PLUME GROUNDWATER TO SWRB	ELEC ON/OFF CONTROL VALVE	F	P-2	I-3	P-5	77-01	4-20MA	120VAC
FQI-119/ FI-119	SO PLUME GROUNDWATER TO SWRB	INDICATING FLOW INTEGRATOR	18-X100 -CLR	P-2	I-3	I-4	61-04	4-20MA	120VAC
FT-119	SO PLUME GROUNDWATER TO SWRB	VORTEX FLOW TRANSMITTER	F	P-2	I-3	P-5	21-01	4-20MA	LOOP
PI-120	NOT USED								
PI-121	NOT USED								
PI-122	NOT USED								
PI-123	NOT USED								
PI-124	NOT USED								

<u>TAG</u>	<u>NO</u>	<u>SERVICE</u>	<u>DESCRIPTION</u>	<u>LOC</u>	<u>P&amp;ID</u>	<u>LOOP</u> <u>SCHM</u>	<u>INST</u> <u>DET</u>	<u>SPEC</u>	<u>SIGNAL</u>	<u>POWER</u>
PI-125		NOT USED								
PI-126		NOT USED								
PI-127		NOT USED								
TR-128		NOT USED								
TE-128A		NOT USED								
TE-128B		NOT USED								
TE-128C		NOT USED								
TE-128D		NOT USED								
TE-128E		NOT USED								
TE-128F		NOT USED								
TE-128G		NOT USED								
TE-128H		NOT USED								
TE-128J		NOT USED								

<u>TAG</u> <u>NO</u>	<u>SERVICE</u>	<u>DESCRIPTION</u>	<u>LOC</u>	<u>P&amp;ID</u>	<u>LOOP</u> <u>SCHM</u>	<u>INST</u> <u>DET</u>	<u>SPEC</u>	<u>SIGNAL</u>	<u>POWER</u>
TE-128K	NOT USED								
TE-128L	NOT USED								
TE-128M	NOT USED								
TE-128N	NOT USED								
TE-128P	NOT USED								
TE-128Q	NOT USED								
TE-128R	NOT USED								
TA-128	NOT USED								
KY-129	COMPOSITE SAMPLING SYSTEM	ADJUSTABLE TIMER	18-X101 -CLR	P-2	I-3	-	99-01	-	120VAC
FY-129	COMPOSITE SAMPLING SYSTEM	FLOW RELAY	18-X101 -CLR	P-2	I-3	-	99-01	-	120VAC
PB-129	COMPOSITE SAMPLING SYSTEM	MANUAL SAMPLE PUSHBUTTON	18-X101 -CLR	P-2	I-3	-	99-01	-	120VAC
QR-129	COMPOSITE SAMPLING SYSTEM	SAMPLE RECORDER	18-X101 -CLR	P-2	I-3	-	99-01	-	120VAC
TS-130	SWRB VENT SYSTEM	TEMP SWITCH	F	-	-	-	84-01	LINE	120VAC

<u>TAG</u>	<u>NO</u>	<u>SERVICE</u>	<u>DESCRIPTION</u>	<u>LOC</u>	<u>P&amp;ID</u>	<u>LOOP</u> <u>SCHM</u>	<u>INST</u> <u>DET</u>	<u>SPEC</u>	<u>SIGNAL</u>	<u>POWER</u>
MS-131		NOT USED								
TE-132		NOT USED								
TS-132		NOT USED								
TE-133		NOT USED								
TS-133		NOT USED								
TE-134		NOT USED								
TE-135		NOT USED								

MFGR

BARCO  
OR APPROVED EQUAL

2850

P & ID

P-2

- 1. Concentric  Other \_\_\_\_\_
- 2. ISA Standard  Other \_\_\_\_\_
- 3. Bore: Maximum Rate  Nearest 1/8 In.
- 4. Material: 304SS  316SS  Other \_\_\_\_\_
- 5. Ring Material & Type \_\_\_\_\_
- 6. MFR & Model No. BARCO BR24658-76-41

- 7. Taps: Flange  Vena Contracta  Pipe  Other \_\_\_\_\_
- 8. Taps: Size 1/2 In.  Other \_\_\_\_\_
- 9. Type: Weld Neck  Slip On  Threaded
- 10. Material: Steel  Other \_\_\_\_\_
- 11. Flanges Included  By others
- 12. Flange Rating 150 LB

Fluid Data	13.	Tag Number	FE-108		
	14.	Service	SOUTH PLUME FORCE MAIN		
	15.	Line Number	GW2		
	16.	Fluid	GROUNDWATER		
	17.	Fluid State			
	18.	Maximum Flow	8000 GPM		
	19.	Normal Flow	2500 GPM		
	20.	Pressure	20 PSI		
	21.	Temperature	60° F		
	22.	Specific Gravity at Base	LO		
	23.	Operating Spec. Gravity	LO		
	24.	Supercomp. Factor			
	25.	Mol. Weight	Cp/Cv		
	26.	Operating Viscosity	LO CP		
27.	Quality % or °Superheat				
28.	Base Press.	Base Temp.			
29.	Line Size	16" O.D.			
30.	Beta = d/D	658			

Notes: PROVIDE BRASS SAFETY SHUT-OFF VALVES  
ON PRESSURE TAPS

251

SOUTH PLUME

CONTRACT NO.

2902-4502

BY

JH

CHECKED

GB

WESTINGHOUSE  
ENVIRONMENTAL MANAGEMENT COMPANY  
OF OHIO

VENTURI  
FLOWMETER

SHEET | OF |

SPECIFICATION  
11-01

DATE ISSUED

12-20-91

REV DATE

REV 0

MFR JOHNSON YOKOGAWA

2850

P & ID		P-2	P-2	P-2	P-2	
METERING ELEMENT	1 Meter Tag No.	FT-B9	FT-III	FT-II2	FT-III3	
	2 Service	GW 2-6'	CE 2-8'	CE 2-6' TO EXIST FORCE MAIN	CE 2-6' TO MH 176B	
	3 Location	SWRB	SWRB	SWRB	SWRB	
	4 CONNS.	Line Size Sched.	4" 40	8" 40	6" 40	6" 40
		5 Line Material	C.S.	C.S.	C.S.	C.S.
		6 Connection Type	150° FLG	150° FLG	150° FLG	150° FLG
		7 Body	WAFER	FLANGED	FLANGED	FLANGED
	8 METER	Body Material	316 SS	C.S.	C.S.	C.S.
		9 <del>Clear Material</del>				
		10 Electrode Type				
		11 Matl., Shedder	STAINLESS	STAINLESS	STAINLESS	STAINLESS
		12 Meter Casing	MFR. STD.	MFR. STD.	MFR. STD.	MFR. STD.
		13 Power Supply	LOOP	LOOP	LOOP	LOOP
		14 Grounding, Type & Matl.				
		15 Enclosure Class	4X	4X	4X	4X
		16 Tag Required	STAINLESS	STAINLESS	STAINLESS	STAINLESS
		17 FLUID	Fluid	GROUNDWATER	STORMWATER	STORMWATER
	18 Max. Flow, Units gpm		1000	1500	1500	1500
	19 Max. Velocity, Units ft/s					
	20 Norm. Flow		700	700	700	700
	21 Min. Flow		150	700	1400	1400
	22 Max. Temp.		80	80	80	80
	23 Min. Temp. °F		32	32	32	32
	24 Max. Press.		80	15	80	80
	25 Min. Press. PSIG	50	10	50	50	
Sp. wt lb/ft <sup>3</sup>	62.4	62.4	62.4	62.4		
Viscosity	1.0 CP	1.0 CP	1.0 CP	1.0 CP		
Ambient Service, °F	32 TO 120					
ASSOCIATED INSTRUMENT	26 Instrument Tag Number	AS ABOVE	AS ABOVE	AS ABOVE	AS ABOVE	
	27 Function	TRANSMIT	TRANSMIT	TRANSMIT	TRANSMIT	
	28 Mounting	INTEGRAL	INTEGRAL	INTEGRAL	INTEGRAL	
	29 Enclosure Class Nema	4X	4X	4X	4X	
	30 Elec. Conn.	1/2" FNPT	1/2" FNPT	1/2" FNPT	1/2" FNPT	
	31 Range (GPM)	0-1000	0-1500	0-1500	0-1500	
	32 Power Supply, VDC	12 TO 45	12 TO 45	12 TO 45	12 TO 45	
	33 TRANS.	Transmitter Output DC	2 WIRE, 4-20 MA	4-20 MA	4-20 MA	4-20 MA
		34 Tag Required	STAINLESS	STAINLESS	STAINLESS	STAINLESS
	35 Manufacturer	JOHNSON	YOKOGAWA	YOKOGAWA	YOKOGAWA	
36 Meter Model Number						
37 Instrument Model Number						

Notes:

YF 110-ALS BIA-S3C6

YF 115-ALS BIA-S3C6

SOUTH PLUME	CONTRACT NO. 2902-4502	BY BB	252 CHECKED FD
WESTINGHOUSE ENVIRONMENTAL MANAGEMENT COMPANY OF OHIO	VORTEX FLOWMETER	SHEET 1 OF 1 SPECIFICATION 21-01	DATE ISSUED 12-20-91 REV DATE REV 0

MFGR

JOHNSON YOKOGAWA  
OR APPROVED EQUAL

2850

P & ID

P-2

	1	Tag No. FT-108	Service SOUTH PLUME FORCE MAIN
GENERAL	2	Function	Record <input type="checkbox"/> Indicate <input type="checkbox"/> Control <input type="checkbox"/> Blind <input type="checkbox"/> Trans <input checked="" type="checkbox"/> Integ <input type="checkbox"/> Other _____
	3	Case	MFR Std <input type="checkbox"/> Nom size _____ Color: MFR Std <input type="checkbox"/> Other _____
	4	Mounting	Flush <input type="checkbox"/> Surface <input type="checkbox"/> Yoke <input type="checkbox"/> Other _____
	5	Enclosure Class	General Purpose <input checked="" type="checkbox"/> Weather proof <input type="checkbox"/> Explosion proof <input type="checkbox"/> Class _____
	6	Power Supply	For use in Intricadly Safe System <input type="checkbox"/> Other _____
	7	Chart	117V 60 Hz <input type="checkbox"/> Other ac _____ dc <input checked="" type="checkbox"/> 24 Volts _____
	8	Chart Drive	12 in. Circ. <input type="checkbox"/> Other _____ Range _____ No. _____
	9	Scale	24 hr Other _____ Elec. <input type="checkbox"/> Spring <input type="checkbox"/> Other _____
		9	Scale
XMTR	10	Transmitter Output	4-20 mA <input checked="" type="checkbox"/> 10-50 mA <input type="checkbox"/> 2I-102 kPA (3-15 psig) <input type="checkbox"/> Other _____ For Receiver, See Spec Sheet 6I-04
	11	Control Modes	P=Prop (Gain) I=Intergal (Auto Reset) D=Derivative (Rate) Sub: s=Slow f=Fast If <input type="checkbox"/> Df <input type="checkbox"/> P <input type="checkbox"/> PI <input type="checkbox"/> PD <input type="checkbox"/> PID <input type="checkbox"/> Is <input type="checkbox"/> Ds <input type="checkbox"/> Other _____
CONTROLLER	12	Action	On Meas. Increase Output _____ Increases _____ Decreases _____
	13	Auto-Man Switch	None <input type="checkbox"/> MFR Std <input type="checkbox"/> Other _____
	14	Set Point Adj.	Manual <input type="checkbox"/> External <input type="checkbox"/> Remote <input type="checkbox"/> Other _____
	15	Manual Reg.	None <input type="checkbox"/> MFR Std <input type="checkbox"/> Other _____
	16	Output	4-20 mA <input type="checkbox"/> 10-50 mA <input type="checkbox"/> 2I-102 kPA (3-15 psig) <input type="checkbox"/> Other _____
ELEMENT	17	Service	Flow <input checked="" type="checkbox"/> Level <input type="checkbox"/> Diff. Pressure <input type="checkbox"/> Other _____
	18	Element Type	Diaphragm <input checked="" type="checkbox"/> Bellows <input type="checkbox"/> Mercury <input type="checkbox"/> Other _____
	19	Material	Body C.S. _____ Element S.S. _____
	20	Rating	Overrange _____ Body Range _____
	21	Diff. Range	Fixed <input type="checkbox"/> Adj. Range 0-250" WC _____ Set At _____
	22		Elevation _____ Suppression _____
	23	Process Data	Fluid WATER _____ Max Temp. 60 °F _____ Max Press. 20 PSI _____
	24	Process Conn.	1/2 in. NPT <input type="checkbox"/> Other _____
25	Alarm Switches	Quantity _____ Form _____ Rating _____	
26	Functions	Meas. Var. <input type="checkbox"/> Deviation <input type="checkbox"/> Contacts To _____ on Inc. Meas.	
27	Options	Pressure Element <input type="checkbox"/> Range _____ Material _____ Temp. Element <input type="checkbox"/> Range _____ Type _____ Filt Reg. <input type="checkbox"/> Filt Reg. <input type="checkbox"/> Sup. Gage <input type="checkbox"/> Output Gage <input type="checkbox"/> _____ Charts Valve Manifold _____ Cond. Pots <input type="checkbox"/> Adj. Damp <input type="checkbox"/> Intergal Sq. Rt. Ext. <input type="checkbox"/> Integrator _____ Other _____	
28	MFR & Model No.	JOHNSON YOKOGAWA YAI-SHK4-B/FMFI/BR2	

Notes: PROVIDE WITH PIPE STAND MOUNTING BRACKET  
AND CARBON STEEL 3-VALVE EQUALIZING MANIFOLD

253

SOUTH PLUME		CONTRACT NO. 2902-4502	BY BB	CHECKED GB
WESTINGHOUSE ENVIRONMENTAL MANAGEMENT COMPANY OF OHIO	DIFFERENTIAL PRESSURE TRANSMITTER	SHEET 1 OF 1	DATE ISSUED 12-20-91	
		SPECIFICATION 2I-02	REV DATE	REV 0

P & ID

GENERAL	1	Tag Number	LT-109							
	2	Service	STORMWATER							
	3	Line No./Vessel No.	CE2-							
	4	Application	LEVEL							
	5	Function	TRANSMIT							
	6	Fall-Safe	LOW LEVEL							
PROBE	7	Model Number	700-1-22							
	8	Orientation								
	9	Style								
	10	Material	S.S.							
	11	Sheath	TEFLON							
	12	Insertion Length	20FT.							
	13	Inactive Length	16FT.							
	14	Gland Size & Mat'l.								
	15									
	16	Conduit Connection								
AMPLIFIER	17	Location	FIELD							
	18	Enclosure	NEMA 4X							
	19	Conduit Connection								
	20	Power Supply	120 VAC							
SWITCH	21	Type								
	22	Quantity and Form								
	23	Rating: Volts/Hz or dc								
	24	Amps/Watts/HP								
	25	Load Type								
	26	Contacts Open	On	Increase						
	27	Close	Level	Decrease						
TRANS.	28	Output	4-20 MA							
	29	Range								
	30	Enclosure Class	NEMA 4X							
OPTIONS	31	Compensation Cable								
	32	Local Indicator	YES							
	33	I/P Transducer								
	34	Signal Lights								
	35									
SERVICE	36	Upper Fluid	WATER							
	37	Dielectric Constant								
	38	Lower Fluid	WATER							
	39	Dielectric Constant								
	40	Pressure Max.	Normal	ATM	ATM					
	41	Temp. Max.	Normal	100 °F						
	42	Moisture	---							
	43	Material Buildup	---							
44	Vibration	---								
45	Manufacturer	DREXELBROOK								
46	Model Number	C508-25-9								

Notes:

SYSTEM INCLUDES

- MODEL 408-6230-2 ELECTRONIC UNIT FIELD MTG.(NEMA 4X) 120 VAC SUPPLY
- MODEL 380-25-12 GEN. PURPOSE CABLE (25 FT.)
- MODEL 285-1-6 CONDULET & FITTING
- MODEL 700-1-22 PROBE 16 FT. IMMERSION 3/8" O.D. ROD, TEFLON INSUL. (3/4" NPT)

254

SOUTH PLUME		CONTRACT NO.	2902-4502	BY	JH	CHECKED	FD
WESTINGHOUSE ENVIRONMENTAL MANAGEMENT COMPANY OF OHIO		LEVEL INSTRUMENTS (CAPACITANCE TYPE)		SHEET	1 OF 1	DATE ISSUED	12-20-91
				SPECIFICATION	22-01	REV DATE	REV 0

MFR

AMETEK (U.S. GAUGE)  
OR APPROVED EQUAL

2850

- 1. Type: Direct Rdg  3-15 lb Receiver   
Other \_\_\_\_\_
- 2. Mounting: Surface  Local  Flush
- 3. Dial: Diameter 4 1/2" Color WHITE
- 4. Case: Cast Iron  Aluminum  Phenol   
Other \_\_\_\_\_
- 5. Ring: Screwed  Hinged  Slip  Std   
Other \_\_\_\_\_
- 6. Blow-out Protection None  Back  Disc   
Solid Front  Other \_\_\_\_\_
- 7. Lens: Glass  Plastic
- 8. Options: Siphon  Material  
Snubber   
Pressure Limit Valve   
Movement Valve
- 9. Nominal Accuracy Required 0.5% OF SPAN

- 10. MFR & Model No. AMETEK 1981
- 11. Pres. Element: Bourdon  Bellows   
Other \_\_\_\_\_
- 12. Element MTL Bronze  Steel 316 SS  
Other \_\_\_\_\_
- 13. Socket MTL Bronze  Steel 316 SS  
Other \_\_\_\_\_
- 14. Connection-NPT: 1/4 in.  1/2 in.  Other \_\_\_\_\_  
Bottom  Back
- 15. Movement: Bronze  SS  Nylon   
Other \_\_\_\_\_
- 16. Diaphragm Seal  
MFG AMETEK Type SB  
Wetted Part MTL 316 SS Other MTL 316 SS  
Fill Fluid M & G INST. OIL  
Process Conn. 3/4" Gage Conn. 1/2"

Rev. Quan.	Tag No.	Range	Operating Pressure	Service
1	PI-110	0-100 PSIG	60 PSIG	SWRB TRANSFER PUMP DISCH. PRESS.

NOTES: PROVIDE DIAPHRAGM SEAL

255

SOUTH PLUME		CONTRACT NO. 2902-4502	BY JH	CHECKED FD
WESTINGHOUSE ENVIRONMENTAL MANAGEMENT COMPANY OF OHIO	PRESSURE GAUGES	SHEET 1 OF 1	DATE ISSUED 12-20-91	
		SPECIFICATION 53-01	REV DATE	REV 0

		MFR	JOHNSON YOKOGAWA OR APPROVED EQUAL	2850
P & ID		P-2		
1	Tag No.	FQI-III	Service	CE2-10'
General	2	Function	Record <input type="checkbox"/> Indicate <input checked="" type="checkbox"/> Control <input type="checkbox"/> Blind <input type="checkbox"/> Integ <input checked="" type="checkbox"/> <input type="checkbox"/> Other _____	
	3	Case	MFR STD <input checked="" type="checkbox"/> Nom. Size _____ Color MFR STD <input checked="" type="checkbox"/> Other _____	
	4	Mounting	Flush <input checked="" type="checkbox"/> Surface <input type="checkbox"/> Rack <input type="checkbox"/> Multi-Case <input type="checkbox"/> Other _____ For Multiple Case. See Spec. Sht.	
	5	Enclosure Class	General Purpose <input checked="" type="checkbox"/> Weather Proof <input type="checkbox"/> Explosion-Proof <input type="checkbox"/> Class <u>NEMA 4</u> For Use in Intrinsically Safe System <input type="checkbox"/> Other _____	
	6	Power Supply	117 V 60Hz <input checked="" type="checkbox"/> Other ac _____ dc <input type="checkbox"/> _____ Volts	
	7	Chart	Strip <input type="checkbox"/> Roll <input type="checkbox"/> Fold <input type="checkbox"/> Circular _____ Time Marks _____ Range _____ Number _____	
	8	Chart Drive	Speed _____ Power _____	
CONTROLLER	9	Scales	Type _____ Range 1 _____ 2 _____ 3 _____ 4 _____	
	10	Control Modes	P=Prop. (Gain) I=Integral (Auto Reset) D=Derivative (Rate) Sub s=Slow f=fast P <input type="checkbox"/> PI <input type="checkbox"/> PID <input type="checkbox"/> I <sub>f</sub> <input type="checkbox"/> D <sub>f</sub> <input type="checkbox"/> I <sub>s</sub> <input type="checkbox"/> D <sub>s</sub> <input type="checkbox"/> Other _____	
	11	Action	On Meas. Increase Output: Increases <input type="checkbox"/> Decreases <input type="checkbox"/>	
	12	Auto-Man Switch	None <input type="checkbox"/> MFR STD <input type="checkbox"/> Other _____	
	13	Set Point Adj.	Manual <input type="checkbox"/> External <input type="checkbox"/> Remote <input type="checkbox"/> Other _____	
INPUT	14	Manual Reg.	None <input type="checkbox"/> MFR STD <input type="checkbox"/> Other _____	
	15	Output	4-20 mA <input type="checkbox"/> 10-50 mA <input type="checkbox"/> 2I-103 kPa (3-15 psig) <input type="checkbox"/> Other _____	
	16	Input Signals	4-20 mA <input checked="" type="checkbox"/> 10-50 mA <input type="checkbox"/> 2I-103 kPa (3-15 psig) <input type="checkbox"/>	
	17	No. of Inputs	1 <input checked="" type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/>	
OUTPUT	18	Power for XMTRS	External <input type="checkbox"/> This Inst <input checked="" type="checkbox"/> No. of Independent Supplies <input type="checkbox"/> For Transmitters. See Specs _____	
	19	Alarm Switches	Quantity _____ Form _____ Rating _____	
	20	Function	Meas. Var. <input type="checkbox"/> Deviation <input type="checkbox"/> Contracts to _____ Others <u>SIGNAL RETRANSMISSION &amp; 4-20 MA</u>	
	21	Options	Filter-Reg <input type="checkbox"/> Supply Gage <input type="checkbox"/> Charts <input type="checkbox"/> Int. Illumination <input type="checkbox"/> Other _____	
	22	MFR & Model No.	JOHNSON YOKOGAWA	YFCT-3AA3-AIA*B/SCT

Notes: MICROPROCESSOR BASED  
MEMORY PROTECTION  
BUILT-IN SELF DIAGNOSTICS  
PARAMETERS ENTERED VIA FRONT-PANEL KEYSTROKE

256

SOUTH PLUME	CONTRACT NO.	2902-4502	BY	BB	CHECKED	FD
WESTINGHOUSE ENVIRONMENTAL MANAGEMENT COMPANY OF OHIO	FLOW TOTALIZER INDICATOR	SHEET 1 OF 1	DATE ISSUED		12-20-91	
		SPECIFICATION 61-01	REV DATE	REV 0		

		MFR	JOHNSON YOKOGAWA OR APPROVED EQUAL	2850
P & ID		P-2		
1	Tag No.	FGI-112	Service	CE2-6'
General	2	Function	Record <input type="checkbox"/> Indicate <input checked="" type="checkbox"/> Control <input type="checkbox"/> Blind <input type="checkbox"/> Integ <input checked="" type="checkbox"/> <input type="checkbox"/> Other _____	
	3	Case	MFR STD <input checked="" type="checkbox"/> Nom. Size _____ Color MFR STD <input checked="" type="checkbox"/> Other _____	
	4	Mounting	Flush <input checked="" type="checkbox"/> Surface <input type="checkbox"/> Rack <input type="checkbox"/> Multi-Case <input type="checkbox"/> Other _____ For Multiple Case. See Spec. Sht.	
	5	Enclosure Class	General Purpose <input checked="" type="checkbox"/> Weather Proof <input type="checkbox"/> Explosion-Proof <input type="checkbox"/> Class NEMA 4 For Use in Intrinsically Safe System <input type="checkbox"/> Other _____	
	6	Power Supply	117 V 60Hz <input checked="" type="checkbox"/> Other ac _____ dc <input type="checkbox"/> _____ Volts	
	7	Chart	Strip <input type="checkbox"/> Roll <input type="checkbox"/> Fold <input type="checkbox"/> Circular _____ Time Marks _____ Range _____ Number _____	
	8	<del>Chart Drive</del>	<del>Speed _____ Power _____</del>	
CONTROLLER	9	<del>Scales</del>	<del>Type _____ Range 1 _____ 2 _____ 3 _____ 4 _____</del>	
	10	<del>Control Modes</del>	<del>P=Prop. (Gain) I=Integral (Auto Reset) D=Derivative (Rate) Sub s=Slow f=Fast P <input type="checkbox"/> PI <input type="checkbox"/> PID <input type="checkbox"/> I<sub>f</sub> <input type="checkbox"/> D<sub>f</sub> <input type="checkbox"/> I<sub>s</sub> <input type="checkbox"/> D<sub>s</sub> <input type="checkbox"/> Other _____</del>	
	11	<del>Action</del>	<del>On Meas. Increase Output: Increases <input type="checkbox"/> Decreases <input type="checkbox"/></del>	
	12	<del>Auto-Man Switch</del>	<del>None <input type="checkbox"/> MFR STD <input type="checkbox"/> Other _____</del>	
	13	<del>Set Point Adj.</del>	<del>Manual <input type="checkbox"/> External <input type="checkbox"/> Remote <input type="checkbox"/> Other _____</del>	
INPUT	14	<del>Manual Reg.</del>	<del>None <input type="checkbox"/> MFR STD <input type="checkbox"/> Other _____</del>	
	15	<del>Output</del>	<del>4-20 mA <input type="checkbox"/> 10-50 mA <input type="checkbox"/> 2-103 kPa (3-15 psig) <input type="checkbox"/> Other _____</del>	
	16	Input Signals	4-20 mA <input checked="" type="checkbox"/> 10-50 mA <input type="checkbox"/> 2-103 kPa (3-15 psig) <input type="checkbox"/>	
OUTPUT	17	No. of Inputs	1 <input checked="" type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/>	
	18	Power for XMTRS	External <input type="checkbox"/> This Inst <input checked="" type="checkbox"/> No. of Independent Supplies <input type="checkbox"/> For Transmitters. See Specs _____	
OUTPUT	19	Alarm Switches	Quantity _____ Form _____ Rating _____	
	20	Function	Meas. Var. <input type="checkbox"/> Deviation <input type="checkbox"/> Contracts to 2-01 Others SIGNAL RETRANSMISSION & 4-20 MA	
	21	Options	Filter-Reg <input type="checkbox"/> Supply Gage <input type="checkbox"/> Charts <input type="checkbox"/> Int. Illumination <input type="checkbox"/> Other _____	
	22	MFR & Model No.	JOHNSON YOKOGAWA YFCT-3AA3-AIA-B/SCT	
Notes: MICROPROCESSOR BASED MEMORY PROTECTION BUILT-IN SELF DIAGNOSTICS PARAMETERS ENTERED VIA FRONT-PANEL KEYSTROKE				257
SOUTH PLUME		CONTRACT NO.	2902-4502	BY BB CHECKED FD
WESTINGHOUSE ENVIRONMENTAL MANAGEMENT COMPANY OF OHIO	FLOW TOTALIZER INDICATOR	SHEET 1 OF 1	DATE ISSUED	12-20-91
		SPECIFICATION 61-02	REV DATE	REV 0

MFR

JOHNSON YOKOGAWA  
OR APPROVED EQUAL

2850

P & ID

P-2

1 Tag No. F01-13 Service CE2-6\*

General

2 Function Record  Indicate  Control  Blind  Integ   
 Other \_\_\_\_\_

3 Case MFR STD  Nom. Size \_\_\_\_\_ Color MFR STD  Other \_\_\_\_\_

4 Mounting Flush  Surface  Rack  Multi-Case  Other \_\_\_\_\_  
 For Multiple Case. See Spec. Sht. \_\_\_\_\_

5 Enclosure Class General Purpose  Weather Proof  Explosion-Proof  Class NEMA 4  
 For Use in Intrinsically Safe System  Other \_\_\_\_\_

6 Power Supply 117 V 60Hz  Other ac \_\_\_\_\_ dc  \_\_\_\_\_ Volts

7 Chart Strip  Roll  Fold  Circular \_\_\_\_\_ Time Marks \_\_\_\_\_  
 Range \_\_\_\_\_ Number \_\_\_\_\_

8 ~~Chart Drive Speed \_\_\_\_\_ Power \_\_\_\_\_~~

9 ~~Scales Type \_\_\_\_\_  
 Range 1 \_\_\_\_\_ 2 \_\_\_\_\_ 3 \_\_\_\_\_ 4 \_\_\_\_\_~~

CONTROLLER

10 ~~Control Modes P=Prop. (Gain) I=Integral (Auto Reset) D=Derivative (Rate) Sub s=Slow f=Fast  
 P  PI  PID  I<sub>f</sub>  D<sub>f</sub>  I<sub>s</sub>  D<sub>s</sub>   
 Other \_\_\_\_\_~~

11 ~~Action On Meas. Increase Output: Increases  Decreases~~

12 ~~Auto-Man Switch None  MFR STD  Other \_\_\_\_\_~~

13 ~~Set Point Adj. Manual  External  Remote  Other \_\_\_\_\_~~

14 ~~Manual Reg. None  MFR STD  Other \_\_\_\_\_~~

15 ~~Output 4-20 mA  10-50 mA  21-103 kPa (3-15 psig)  Other \_\_\_\_\_~~

INPUT

16 Input Signals 4-20 mA  10-50 mA  21-103 kPa (3-15 psig)

17 No. of Inputs 1  2  3  4

18 Power for XMTRS External  This Inst  No. of Independent Supplies   
 For Transmitters. See Specs 21-01

OUTPUT

19 Alarm Switches Quantity \_\_\_\_\_ Form \_\_\_\_\_ Rating \_\_\_\_\_

20 Function Meas. Var.  Deviation  Contracts to \_\_\_\_\_  
 Others SIGNAL RETRANSMISSION & 4-20 MA

21 Options Filter-Reg  Supply Gage  Charts  Int. Illumination   
 Other \_\_\_\_\_

22 MFR & Model No. JOHNSON YOKOGAWA YFCT-3AA3-AIA#B/SCT

Notes: MICROPROCESSOR BASED  
 MEMORY PROTECTION  
 BUILT-IN SELF DIAGNOSTICS  
 PARAMETERS ENTERED VIA FRONT-PANEL KEYSTROKE

258

SOUTH PLUME		CONTRACT NO.	2902-4502	BY	BB	CHECKED	FD
WESTINGHOUSE ENVIRONMENTAL MANAGEMENT COMPANY OF OHIO		FLOW TOTALIZER INDICATOR		SHEET	1 OF 1	DATE ISSUED	12-20-91
				SPECIFICATION	61-03	REV DATE	REV 0

		MFR		JOHNSON YOKOGAWA OR APPROVED EQUAL		2850		
		P & ID						
1		Tag No.	FQI-19	Service	GW2-6'			
General	2	Function	Record <input type="checkbox"/> Indicate <input checked="" type="checkbox"/> Control <input type="checkbox"/> Blind <input type="checkbox"/> Integ <input checked="" type="checkbox"/> <input type="checkbox"/> Other _____					
	3	Case	MFR STD <input checked="" type="checkbox"/> Nom. Size _____ Color MFR STD <input checked="" type="checkbox"/> Other NEMA 4					
	4	Mounting	Flush <input checked="" type="checkbox"/> Surface <input type="checkbox"/> Rack <input type="checkbox"/> Multi-Case <input type="checkbox"/> Other _____ For Multiple Case. See Spec. Sht. _____					
	5	Enclosure Class	General Purpose <input type="checkbox"/> Weather Proof <input type="checkbox"/> Explosion-Proof <input checked="" type="checkbox"/> Class _____ For Use in Intrinsically Safe System <input type="checkbox"/> Other _____					
	6	Power Supply	117 V 60Hz <input checked="" type="checkbox"/> Other ac _____ dc _____ Volts					
	7	Chart	Strip <input type="checkbox"/> Roll <input type="checkbox"/> Fold <input type="checkbox"/> Circular _____ Time Marks _____ Range _____ Number _____					
	8	Chart Drive	Speed _____ Power _____					
	9	Scales	Type _____ Range 1 _____ 2 _____ 3 _____ 4 _____					
CONTROLLER	10	Control Modes	P=Prop. (Gain) I=Integral (Auto Reset) D=Derivative (Rate) Sub s=Slow f=Fast P <input type="checkbox"/> PI <input type="checkbox"/> PID <input type="checkbox"/> If <input type="checkbox"/> Df <input type="checkbox"/> Is <input type="checkbox"/> Ds <input type="checkbox"/> Other _____					
	11	Action	On Meas. Increase Output: Increases <input type="checkbox"/> Decreases <input type="checkbox"/>					
	12	Auto-Man Switch	None <input type="checkbox"/> MFR STD <input type="checkbox"/> Other _____					
	13	Set Point Adj.	Manual <input type="checkbox"/> External <input type="checkbox"/> Remote <input type="checkbox"/> Other _____					
	14	Manual Reg.	None <input type="checkbox"/> MFR STD <input type="checkbox"/> Other _____					
INPUT	15	Output	4-20 mA <input type="checkbox"/> 10-50 mA <input type="checkbox"/> 2-103 kPa (3-15 psig) <input type="checkbox"/> Other _____					
	16	Input Signals	4-20 mA <input checked="" type="checkbox"/> 10-50 mA <input type="checkbox"/> 2-103 kPa (3-15 psig) <input type="checkbox"/>					
	17	No. of Inputs	1 <input checked="" type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/>					
OUTPUT	18	Power for XMTRS	External <input type="checkbox"/> This Inst <input checked="" type="checkbox"/> No. of Independent Supplies <input type="checkbox"/> For Transmitters. See Specs 21-01					
	19	Alarm Switches	Quantity _____ Form _____ Rating _____					
20	Function	Meas. Var. <input type="checkbox"/> Deviation <input type="checkbox"/> Contracts to _____ Others SIGNAL RETRANSMISSION & 4-20 MA						
	Options	Filter-Reg <input type="checkbox"/> Supply Gage <input type="checkbox"/> Charts <input type="checkbox"/> Int. Illumination <input type="checkbox"/> Other _____						
22	MFR & Model No.	JOHNSON YOKOGAWA	YFCT-3AA3-A1A*B/SCT					

Notes: MICROPROCESSOR BASED  
MEMORY PROTECTION  
BUILT-IN SELF DIAGNOSTICS  
PARAMETERS ENTERED VIA FRONT-PANEL KEYSTROKE

259

SOUTH PLUME		CONTRACT NO.	2902-4502	BY	BB	CHECKED
WESTINGHOUSE ENVIRONMENTAL MANAGEMENT COMPANY OF OHIO		FLOW TOTALIZER INDICATOR		SHEET	1 OF 1	DATE ISSUED
				SPECIFICATION	61-04	REV DATE
						12-20-91
						REV 0

		MFR	JOHNSON YOKOGAWA OR APPROVED EQUAL	2850	
P & ID					
1	Tag No.	LIC-109 Service SWRB TRANSFER STATION LEVEL			
General	2	Function	Record <input type="checkbox"/> Indicate <input checked="" type="checkbox"/> Control <input checked="" type="checkbox"/> Blind <input type="checkbox"/> Integ <input type="checkbox"/> <input type="checkbox"/> Other _____		
	3	Case	MFR STD <input checked="" type="checkbox"/> Nom. Size <u>1/4 DIN</u> Color MFR STD <input checked="" type="checkbox"/> Other _____		
	4	Mounting	Flush <input checked="" type="checkbox"/> Surface <input type="checkbox"/> Rack <input type="checkbox"/> Multi-Case <input type="checkbox"/> Other _____ For Multiple Case. See Spec. Sht. _____		
	5	Enclosure Class	General Purpose <input checked="" type="checkbox"/> Weather Proof <input type="checkbox"/> Explosion-Proof <input type="checkbox"/> Class _____ For Use in Intrinsically Safe System <input type="checkbox"/> Other _____		
	6	Power Supply	117 V 60Hz <input checked="" type="checkbox"/> Other ac _____ dc <input type="checkbox"/> _____ Volts		
	7	Chart	Strip <input type="checkbox"/> Roll <input type="checkbox"/> Fold <input type="checkbox"/> Circular _____ Time Marks _____ Range _____ Number _____		
	8	Chart Drive	Speed _____ Power _____		
	9	Scales	Type _____ Range 1 _____ 2 _____ 3 _____ 4 _____		
	CONTROLLER	10	Control Modes	P=Prop. (Gain) I=Integal (Auto Reset) D=Derivative (Rate) Sub s=Slow f=Fast P <input type="checkbox"/> PI <input type="checkbox"/> PID <input checked="" type="checkbox"/> If <input type="checkbox"/> Df <input type="checkbox"/> Is <input type="checkbox"/> Ds <input type="checkbox"/> Other _____	
11		Action	On Meas. Increase Output: Increases <input type="checkbox"/> Decreases <input type="checkbox"/>		
12		Auto-Man Switch	None <input type="checkbox"/> MFR STD <input checked="" type="checkbox"/> Other _____		
13		Set Point Adj.	Manual <input checked="" type="checkbox"/> External <input type="checkbox"/> Remote <input type="checkbox"/> Other _____		
14		Manual Reg.	None <input type="checkbox"/> MFR STD <input type="checkbox"/> Other _____		
INPUT	15	Output	4-20 mA <input checked="" type="checkbox"/> 10-50 mA <input type="checkbox"/> 21-103 kPa (3-15 psig) <input type="checkbox"/> Other _____		
	16	Input Signals	4-20 mA <input checked="" type="checkbox"/> 10-50 mA <input type="checkbox"/> 21-103 kPa (3-15 psig) <input type="checkbox"/>		
	17	No. of Inputs	1 <input checked="" type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/>		
	18	Power for XMTRS	External <input checked="" type="checkbox"/> This Inst <input type="checkbox"/> No. of Independent Supplies <input type="checkbox"/> For Transmitters. See Specs <u>22-01</u>		
OUTPUT	19	Alarm Switches	Quantity <u>2</u> Form _____ Rating <u>.3A (230 VAC)</u>		
	20	Function	Meas. Var. <input checked="" type="checkbox"/> Deviation <input type="checkbox"/> Contacts to <u>CLOSE</u> On Meas. <u>INC. ISET/ DEC. ISET</u> Others <u>SIGNAL RETRANSMISSION &amp; 4-20 MA</u>		
	21	Options	Filter-Reg <input type="checkbox"/> Supply Gage <input type="checkbox"/> Charts <input type="checkbox"/> Int. Illumination <input type="checkbox"/> Other _____		
	22	MFR & Model No.	JOHNSON YOKAGAWA UT40-131B/RET		
Notes 260					
SOUTH PLUME		CONTRACT NO.	2902-4502	BY JH	CHECKED GB
WESTINGHOUSE ENVIRONMENTAL MANAGEMENT COMPANY OF OHIO		DIGITAL INDICATING CONTROLLER		SHEET 1 OF 1	DATE ISSUED 12-20-91
				SPECIFICATION 62-01	REV DATE

MFRGR JOHNSON YOKOGAWA  
OR APPROVED EQUAL

2850

P & ID

1	Tag No.	FQR-108	Service	GW2-16'
General	2	Function	Record <input checked="" type="checkbox"/> Indicate <input checked="" type="checkbox"/> Control <input type="checkbox"/> Blind <input type="checkbox"/> Integ <input checked="" type="checkbox"/> <input type="checkbox"/> Other _____	
	3	Case	MFR STD <input checked="" type="checkbox"/> Nom. Size _____ Color MFR STD <input checked="" type="checkbox"/> Other _____	
	4	Mounting	Flush <input checked="" type="checkbox"/> Surface <input type="checkbox"/> Rack <input type="checkbox"/> Multi-Case <input type="checkbox"/> Other _____ For Multiple Case. See Spec. Sht. _____	
	5	Enclosure Class	General Purpose <input checked="" type="checkbox"/> Weather Proof <input type="checkbox"/> Explosion-Proof <input type="checkbox"/> Class 4X For Use in Intrinsically Safe System <input type="checkbox"/> Other _____	
	6	Power Supply	117 V 60Hz <input checked="" type="checkbox"/> Other ac _____ dc <input type="checkbox"/> _____ Volts	
	7	Chart	Strip <input checked="" type="checkbox"/> Roll <input type="checkbox"/> Fold <input type="checkbox"/> Circular _____ Time Marks _____ Range -6 TO 6V _____ Number 1	
	8	Chart Drive	Speed _____ Power _____	
9	Scales	Type _____ Range 1 _____ 2 _____ 3 _____ 4 _____		

CONTROLLER	10	Control Modes	P=Prop. (Gain) I=Intergal (Auto Reset) D=Derivative (Rate) Sub s=Slow f=Fast P <input type="checkbox"/> PI <input type="checkbox"/> PID <input type="checkbox"/> If <input type="checkbox"/> Df <input type="checkbox"/> Is <input type="checkbox"/> Ds <input type="checkbox"/> Other _____
	11	Action	On Meas. Increase Output: Increases <input type="checkbox"/> Decreases <input type="checkbox"/>
	12	Auto-Man Switch	None <input type="checkbox"/> MFR STD <input type="checkbox"/> Other _____
	13	Set Point Adj.	Manual <input type="checkbox"/> External <input type="checkbox"/> Remote <input type="checkbox"/> Other _____
	14	Manual Reg.	None <input type="checkbox"/> MFR STD <input type="checkbox"/> Other _____
	15	Output	4-20 mA <input type="checkbox"/> 10-50 mA <input type="checkbox"/> 2I-103 kPa (3-15 psig) <input type="checkbox"/> Other _____

INPUT	16	Input Signals	4-20 mA <input checked="" type="checkbox"/> 10-50 mA <input type="checkbox"/> 2I-103 kPa (3-15 psig) <input type="checkbox"/>
	17	No. of Inputs	1 <input checked="" type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/>
	18	Power for XMTRS	External <input type="checkbox"/> This Inst <input checked="" type="checkbox"/> No. of Independent Supplies <input type="checkbox"/> For Transmitters. See Specs 2I-02

OUTPUT	19	Alarm Switches	Quantity _____ Form _____ Rating _____
	20	Function	Meas. Var. <input type="checkbox"/> Deviation <input type="checkbox"/> Contracts to _____ Others SIGNAL RETRANSMISSION & 4-20 MA

21	Options	Filter-Reg <input type="checkbox"/> Supply Gage <input type="checkbox"/> Charts <input type="checkbox"/> Int. Illumination <input type="checkbox"/> Other _____
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22	MFR & Model No.	JOHNSON YOKOGAWA MICRO ROOT 100T-426I
----	-----------------	---------------------------------------

Notes: MICROPROCESSOR BASED  
MEMORY PROTECTION  
BUILT-IN SELF DIAGNOSTICS  
PARAMETERS ENTERED VIA FRONT-PANEL KEYSTROKE  
SIGNAL TO PEN NO. 115 INTERNALLY TOTALIZED. CALIBRATE TO TOTALIZE 100 GAL. PER COUNT.

261

SOUTH PLUME		CONTRACT NO.	2902-4502	BY	BB	CHECKED	GB
WESTINGHOUSE ENVIRONMENTAL MANAGEMENT COMPANY OF OHIO		FLOW TOTALIZER RECORDER		SHEET	1 OF 1	DATE ISSUED	12-20-91
		SPECIFICATION		REV DATE		REV	0
		63-01					

		MFGR	KEYSTONE OR APPROVED EQUAL	2850
P & D		P-2		
Valve Tag No.	FV-17			
Location	SWRB			
Pipe Size/Spec.	GW2-6"			
Valve Construction	BUTTERFLY			
End Conns. Size/Type	6" WAFER, 150# FLG			
Body Material	C.I.			
Disc/Seat/Stem Mat'l	316 S.S./EPDM/SS			
Failure Position	LAST			
Valve Mfr.	KEYSTONE			
Model No.	FIG. 100			
Valve Detail No.				
Stem Conn./Size	MFR. STD.			
Leak Specification	CLASS V			
Actuator	KEYSTONE			
Type	ELECTRIC			
Size/Output Torque	777-EPI-6			
Max Travel/Stroke Speed	90" /MFR. STD.			
Power Supply	80 VAC			
Motor Type	20% DUTY CYCLE			
Actuator Mat'l	MFG. STD.			
Housing/Worm/Worm Gear	ANODIZED AL/MFR. STD./MFR. STD.			
Starter Housing/Yoke				
Enclosure Classification	NEMA 4X			
Electrical Connections	3/4" FNPT			
Gear Box				
Size/Torque				
Hand Wheel Dims.	MFR. STD.			
Materials				
Process Fluid	GROUNDWATER			
Temperature: Max./Norm °F	60/60			
Max. Inlet Press. PSIG	15			
Press. Drop Max./Min. PSI	70/10			
Flow Rate Max./Min./Norm.	700/0/700 GPM			
Limit Switch	2 EACH, DPST			
Electrical Classification	NEMA 4X			
Position Indicator Local	YES			
Remote Position Trans.	4-20 MADC OUTPUT			
Padlockable Local Switch	NO			
Ambient Conditions	50-102 °F			
				262

SOUTH PLUME		CONTRACT NO.	2902-4502	BY	BB	CHECKED	GB
WESTINGHOUSE ENVIRONMENTAL MANAGEMENT COMPANY OF OHIO		MOTORIZED ON-OFF VALVES		SHEET 1 OF 1		DATE ISSUED 12-20-91	
				SPECIFICATION 77-01		REV DATE REV 0	

		MFR	KEYSTONE OR APPROVED EQUAL	2850
P & ID		P-2		
Valve Tag No.		LV-109		
Location		SWRB		
Pipe Size/Spec.		GW2-6"		
Valve Construction		BUTTERFLY		
End Conns. Size/Type		4" WAFER, 150#. FLG		
Body Material		C.S.		
Disc/Seat/Stem Mat'l		SS/SS/SS		
Failure Position		LAST		
Valve Mfr.		KEYSTONE		
Model No.		FIG. AR2		
Valve Detail No.				
Stem Conn./Size		MFR. STD.		
Leak Specification				
Actuator		CLASS IV		
Type		ELECTRIC		
Size/Output Torque		777-EPI-6		
Max Travel/Stroking Speed		90° /MFR. STD.		
Power Supply		110 VAC		
Motor Type		100% DUTY CYCLE		
Actuator Mat'l		MFR. STD.		
Housing/Worm/Worm Gear		MFR. STD.		
Starter Housing/Yoke		MFR. STD.		
Enclosure Classification		NEMA 4X		
Electrical Connections		MFR. STD.		
Input Signals		4-20 MADC		
Gear Box		MFR. STD.		
Size/Torque		MFR. STD.		
Hand Wheel Dims.		MFR. STD.		
Materials		MFR. STD.		
Process Fluid		GROUNDWATER		
Temperature: Max./Norm °F		60/60		
Max. Inlet Press. PSIG		20		
Press. Drop Max./Min. PSI		20/10		
Flow Rate Max./Min./Norm.		150/700/700 GPM		
Limit Switch		NONE		
Electrical Classification				
Position Indicator Local		LOCAL		
Remote Position Indicator		4-20 MADC OUTPUT		
Padlockable Local Switch		NO		
Ambient Conditions		50-102 °F		

NOTES: PROVIDE WITH SERVO AMPLIFIER/SPEED CONTROL MODULE.

263

SOUTH PLUME		CONTRACT NO.	2902-4502	BY	BB	CHECKED
WESTINGHOUSE ENVIRONMENTAL MANAGEMENT COMPANY OF OHIO		MOTORIZED THROTTLING VALVES		SHEET	1 OF 1	DATE ISSUED
				SPECIFICATION	78-01	REV DATE
						12-20-91
						REV 0

MFGR

HONEYWELL  
OR APPROVED EQUAL

2850

P & ID

GENERAL

- 1. Type: Pneu.  Elec
- 2. Setting: Set in Field  Factory Set   
Internal  External  Dial
- 3. Dead Band: Fixed  Adj.  Min.

ELEMENT

- 4. Type: Diaphragm  Bourdon  Bellows   
Other \_\_\_\_\_
- 5. Material: Bronze  \_\_\_\_\_ SS  Alloy St.   
Other \_\_\_\_\_
- 6. Connection: MFR STD  Other Size \_\_\_\_\_  
Bottom  Back
- 7. Mounting: Local  Surface  Flush

SWITCH

- 8. Type: Mercury  Snap   
Other BIMETAL \_\_\_\_\_
- 9. Quantity: Single  Dual
- 10. Form: SPST  SPDT  DPDT   
Other \_\_\_\_\_
- 11. Rating: 7.5 Amps 120 V 60 Hz  
Other \_\_\_\_\_
- 12. Load: Inductive  Non-Inductive
- 13. Enclosure: General Purpose  Weather Proof   
None  Explosion proof  Class \_\_\_\_\_
- 14. Conduit Connection: MFR STD  Other \_\_\_\_\_  
Manufacturer & Model No. \_\_\_\_\_

Rev.	Tag No.	Model No.	Operating Condition	Set Point Adj. Range	Thermometer	Service	Notes
					Temp. Range		
	TS-130	T651A	N.O.	56-94 °F	60-90 °F	SWRB VALVE HOUSE VENTILATION	1

Notes

1. PROVIDE WITH 0473A SWITCHING SUB-BASE

264

SOUTH PLUME		CONTRACT NO.	2902-4502	BY	JCW	CHECKED	GB
WESTINGHOUSE ENVIRONMENTAL MANAGEMENT COMPANY OF OHIO		TEMPERATURE AND HUMIDITY SWITCHES		SHEET	1	OF	1
				DATE ISSUED		12-20-91	
		SPECIFICATION		REV DATE		REV	0
		84-01					

DESCRIPTION: COMPOSITE SAMPLING SYSTEM

EQUIPMENT NO: 18-X100-SMP SHEET 1 OF 2  
18-X102-CLR

ID. NO. 99-01

QUANTITY REQUIRED: ONE

The sampling system shall be for drawing fresh sample from a sealed circulation line. The system shall have all the equipment necessary for representatively collecting and preserving by refrigeration composite liquid samples. The system shall consist of a flow-through sampler that maintains a seal on the circulation line, a control, and a refrigerator. The sampler shall be mounted directly to the circulation line. The sample shall flow by gravity from the sampler to the refrigerator sample storage.

The sampler shall be constructed of reinforced PVC, NEMA 4X. It shall have a fixed displacement chamber, designed to take equal sample volumes during sampling cycles, independent of fluctuation in line pressure and flow rate. The sampler shall accommodate pressures up to 75 PSI. The sampler shall mount in a 1-1/2 inch fitting on the side of the circulation line. The sample shall be taken from the sealed line, keeping the effluent to be sampled enclosed, away from personnel, to maintain a safe, sanitary and orderly environment at the sampling location.

To minimize abrasion and provide long life, the ball sampling chamber shall be of 316 stainless steel with Teflon seats. The sampler shall be easily disassembled for cleaning. It shall take a sample of 45ml volume during each sample cycle, initiated from an integral timer/controller or an external flow meter signal. The gravity flow from the sampler shall be connected directly to a 2-1/2 gallon composite sample container by a 3/4 inch diameter transfer tube. The sample container shall be located in the refrigerator.

The control for the sampler shall provide both time interval and flow proportional sampling modes. The time interval mode shall provide for time based samples, operation on a continuous running time. It shall use a microcomputer display timer for presetting the time between samples. The timer shall trigger the sampler to sample each time the preset sample period occurs. This mode shall allow the sample period to be set from one sample per minute to one sample every 99.9 minutes (in one/tenth minute increments), and repeat.

To pace sampling, the flow proportional mode shall use the customer's 4-20 mAdc signal, directly proportional to flow. Using this signal, an integrator in the control shall provide a pulse every ten gallons of flow. A display counter shall provide for presetting the number of 10-gallon flow units between samples. When the set quantity of flow units is realized, the sampling system shall take a fixed 45cc sample. This flow proportional mode shall allow the sample period to be set from one to 999 units, and repeat. The control shall be equipped with a three-digit LED display indicating the number of minutes or pulses remaining before the next sample.

The microcomputer timer shall be used during flow proportional sampling as a time override feature. Time override shall function during extremely low flow periods, when it is desired to have a sample periodically, even though the period flow does not reach the set quantity during that cycle. The timer shall take the sample and reset the counter and timer.

The sampler shall be equipped with an adjustable sample-counting preset counter, which shall count the samples as they are taken and turn off the unit when the number of samples set had been achieved. Sampler operation shall terminate automatically with a completed sample program. The completed program condition shall be indicated by a front panel light.

It shall be possible, utilizing a pushbutton, to manually initiate a sample cycle without interrupting the preset program.

The control panel shall be NEMA 4 construction, mounted to the refrigerated compartment.

The refrigerator shall be thermostatically controlled and capable of maintaining samples at 34-42 degrees F during the collection period and until analysis can be performed. It shall contain a 2-1/2 gallon capacity, high density polypropylene jug. The outside of the refrigerator shall be painted, using a product that is highly resistant to moisture.

The sampling system shall operate from 120 volt AC power. All dials, switches and pushbuttons on the control panel shall be clearly marked for function and application.

**SUGGESTED MANUFACTURER:**

J. L. Rochester Company  
c/o Samco-Municipal & Industrial Equipment  
P.O. Box 42632  
5616 Bayberry Drive  
Cincinnati, Ohio 45242

APPENDIX E - INSTRUMENT INSTALLATION DETAIL DRAWINGS

<u>I.D. NO.</u>	<u>DESCRIPTION</u>	<u>REV.</u>	<u>DATE</u>	<u>NO. OF PAGES</u>
01	Mouting Details, Field Mounted Instruments	A	5-31-91	5

JOB: 2902-4502

LOC: FERNALD, OHIO

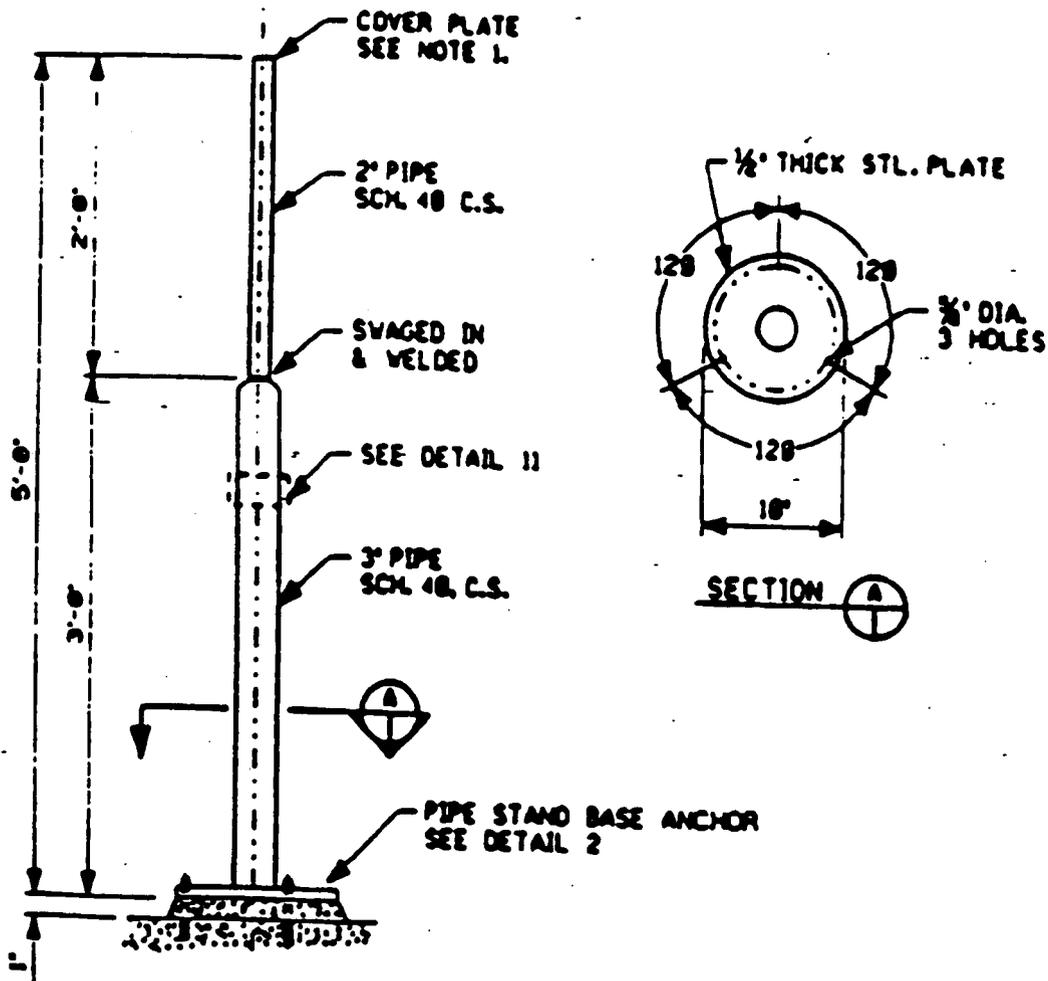
DRAWN BY: JCW DATE: 5-91

CHECKED BY: \_\_\_\_\_ DATE: \_\_\_\_\_

2850

INSTRUMENT INSTALLATION DETAIL

MOUNTING DETAILS  
FIELD MOUNTED INSTRUMENTS



NOTE:

1. SEAL WELD COVER PLATE OVER ALL OPEN PIPE ENDS.

DETAIL 1

268

# A. M. KINNEY, INC.

INDUSTRIAL AND PROCESS DESIGN CONSULTANT  
CINCINNATI NEW YORK CHICAGO

ID NO. 01

SHEET 2 OF 5

JOB: 2902-4502

LOC: FERNALD, OHIO

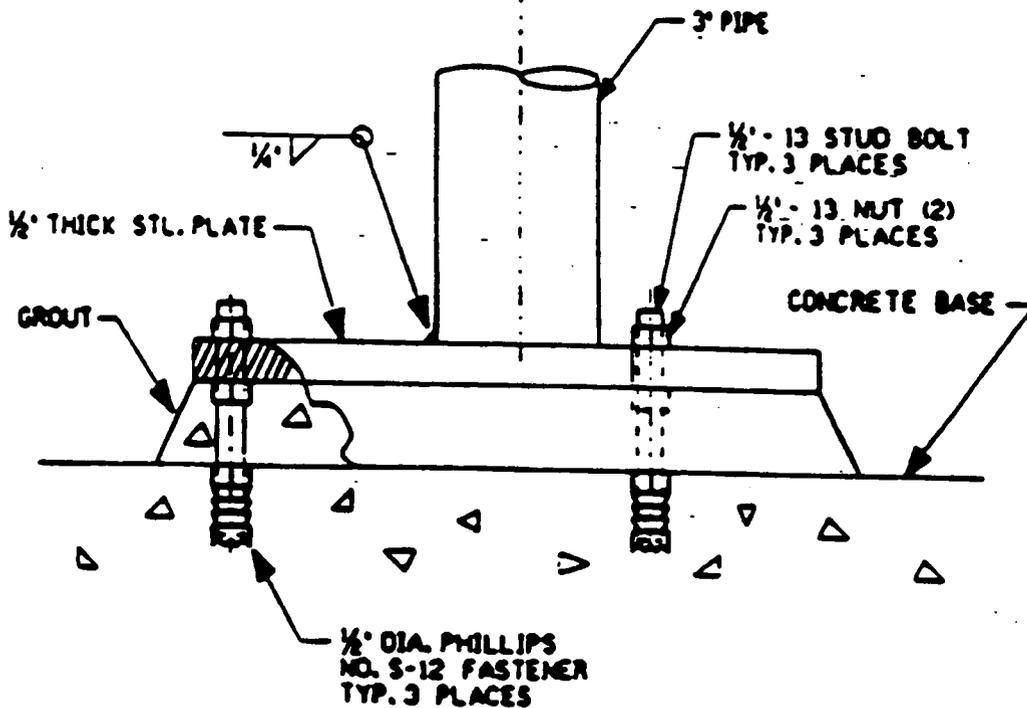
DRAWN BY: JEW DATE: 5-91

CHECKED BY: \_\_\_\_\_ DATE: \_\_\_\_\_

2850

## INSTRUMENT INSTALLATION DETAIL

### MOUNTING DETAILS FIELD MOUNTED INSTRUMENTS



DETAIL 2  
BASE ANCHOR FOR PIPE STAND

# A. M. KINNEY, INC.

ID. NO. 01

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CINCINNATI NEW YORK CHICAGO

SHEET 3 OF 5

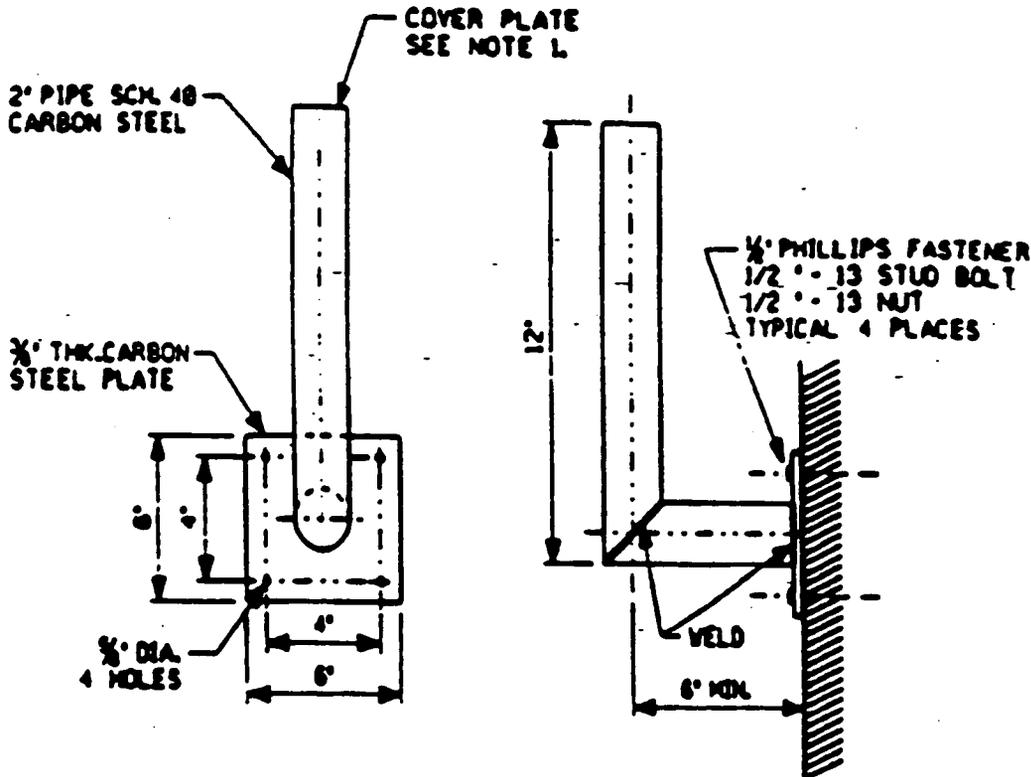
2850

JOB: 2902-4502  
LOC: FERNALD, OHIO

DRAWN BY: JW DATE: 5-91  
CHECKED BY: \_\_\_\_\_ DATE: \_\_\_\_\_

## INSTRUMENT INSTALLATION DETAIL

### MOUNTING DETAILS FIELD MOUNTED INSTRUMENTS



**NOTE:**

- 1. SEAL WELD COVER PLATE OVER ALL OPEN PIPE ENDS.

### DETAIL 8

WALL OR COLUMN MOUNTING  
(CONCRETE)

270

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ID NO. 01

SHEET 4 OF 5

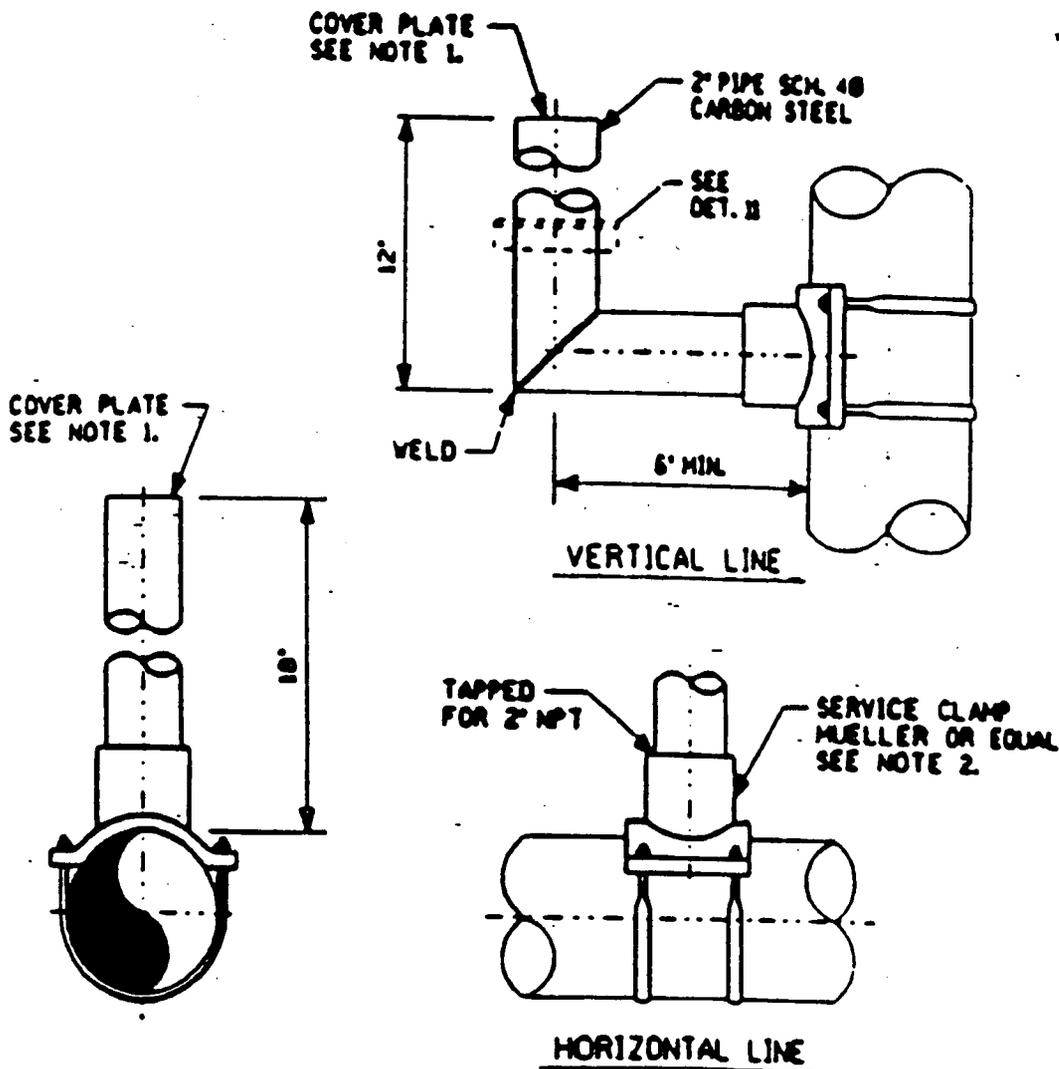
2850

JOB: 2902-4502  
LOC: FERNALD, OHIO

DRAWN BY: JEW DATE: 5-91  
CHECKED BY: \_\_\_\_\_ DATE: \_\_\_\_\_

## INSTRUMENT INSTALLATION DETAIL

### MOUNTING DETAILS FIELD MOUNTED INSTRUMENTS



#### NOTE:

1. SEAL WELD COVER PLATE OVER ALL OPEN PIPE ENDS.
2. USE SERVICE CLAMP FOR LINE MOUNTING SUPPORT ON 1/2" TO 14" LINES. USE DETAIL 10 ON 16" AND LARGER LINES. DO NOT WELD STANCHIONS AND MOUNTINGS TO PROCESS LINES.

### DETAIL 10

LINE MOUNTING (PREFERRED)  
ALSO SEE DET. 11

271

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CINCINNATI NEW YORK CHICAGO

ID NO. 01  
SHEET 5 OF 5

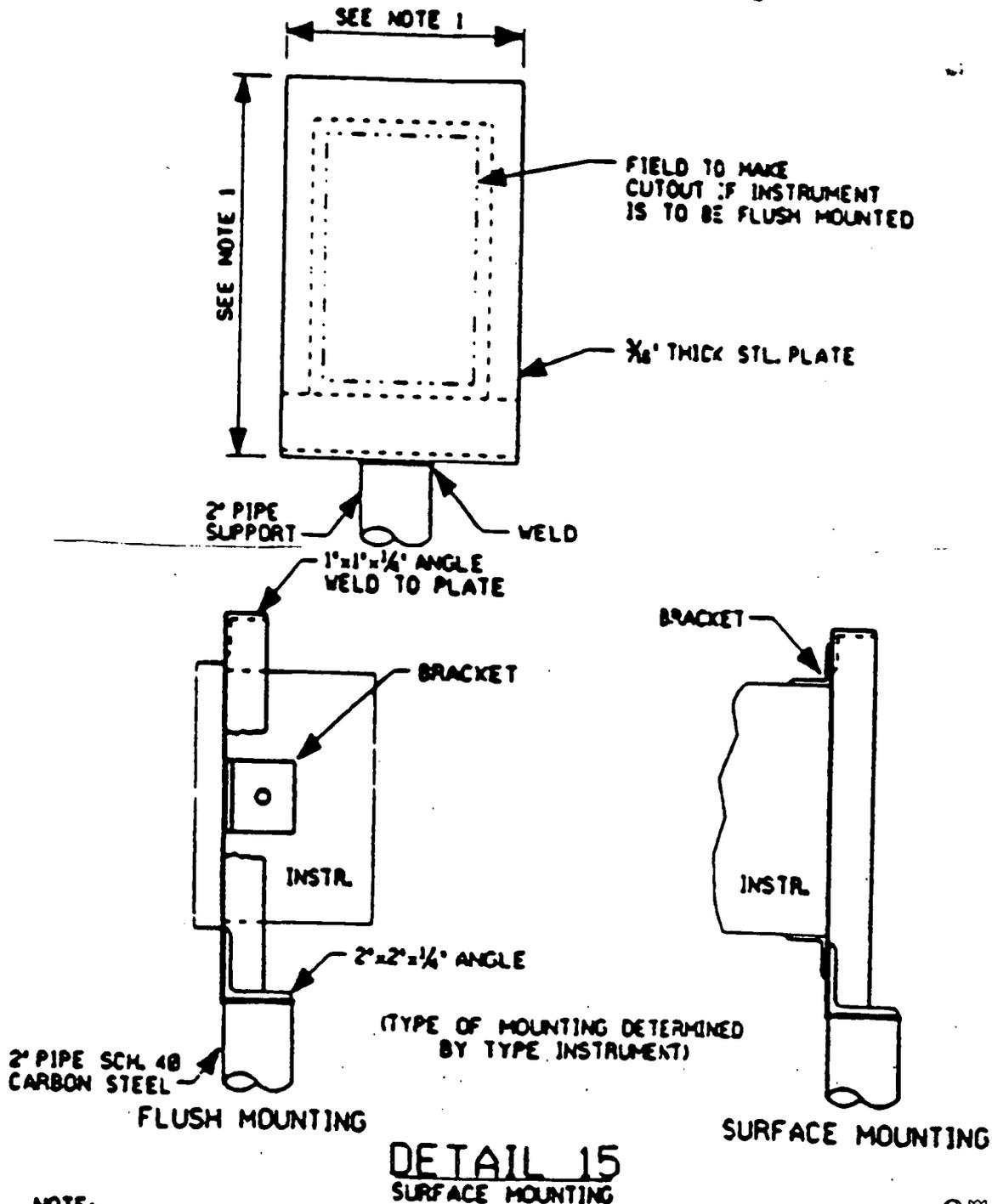
JOB: 2902-4502  
LOC: FERNALD, OHIO

2850

DRAWN BY: JCW DATE: 5-91  
CHECKED BY: \_\_\_\_\_ DATE: \_\_\_\_\_

## INSTRUMENT INSTALLATION DETAIL

### MOUNTING DETAILS FIELD MOUNTED INSTRUMENTS



#### NOTE:

1. SIZE OF MOUNTING PLATE, CUTOUTS AND MOUNTINGS TO BE DETERMINED BY FIELD.

272

2850

APPENDIX F - OPERATING CONTRACTOR-FURNISHED PIPING MATERIAL SPECIFICATIONS

273

PIPING MATERIAL SPECIFICATION 4502 - 60 -01

SERVICE: Underground - Treated Water (TWX1), Groundwater (GW1) Contaminated effluent (CE1)  
PRIMARY RATING: 160 PSI CORR. ALLOW: 0  
MAX. TEMP: 73.4 degree F BASIC MATERIAL: HDPE

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- Pipe: Polyethylene P34CH compound, PE 3408, SDR 11, ASTM D 1248, Type III, Class C, Category 5, Grade P34.
- Joints: Butt fusion heat joined.
- Fittings: Butt type, factory fabricated from same material as pipe, ASTM D 1248.
- Flanges: Ductile Iron, 125 pound, lap joint, AWWA C 207, Class D. Use flanges only for mating with valves, and where shown on the drawings:
- Gaskets: Neoprene, 1/8 inch, full faced.
- Bolts and Nuts: Machine bolts and nuts, Class 150, heavy hex head, cadmium plated, ASTM A 307B.
- Washers: Type A, plain narrow series, cadmium plated ANSI B27.2.

Polyethylene piping, fittings and appurtenances to be by the same manufacturer, of identical virgin material, and to have a cell classification in accordance with ASTM D 3350. The minimum hydrostatic design basis to be 1,600 psig at 73.4 degree F and 800 psig at 140 degree F per ASTM D 2387 and validated in accordance with Plastic Pipe Institute PPI TR-3. The pipe to have tensile strength at yield point per ASTM D 638 of a nominal molecular weight average of 300,000. Piping materials to be Plexco EHMW, Driscopipe 1000, or approved equal.

Militered fittings to be fully pressure rated. A 90 degree elbow to have five segments and a 45 degree elbow to have 3 segments.

PIPING MATERIAL SPECIFICATION

4502 - 60 -03

SERVICE: Outfall Sewer (ST1)  
PRIMARY RATING: 50 PSI  
MAX. TEMP: 73.4 degree F

CORROSION ALLOWANCE: 0  
BASIC MATERIAL: HDPE

- 
- Pipe: Polyethylene P34CH compound, PE 3408, SDR 32.5, ASTM D 1248, Type III, Class C, Category 5, Grade P34.
- Joints: Butt fusion heat joined.
- Fittings: Butt type, factory fabricated from same material as pipe, ASTM D 1248.
- Flanges: Ductile Iron, 125 pound, lap joint, AWWA C 207, Class D. Use flanges only for mating with valves, and where shown on the drawings:
- Gaskets: Neoprene, 1/8 inch, full faced.
- Bolts and Nuts: Machine bolts and nuts, Class 150, heavy hex head, cadmium plated, ASTM A 307B.
- Washers: Type A, plain narrow series, cadmium plated ANSI B27.2.

Polyethylene piping, fittings and appurtenances to be by the same manufacturer, of identical virgin material, and to have a cell classification in accordance with ASTM D 3350. The minimum hydrostatic design basis to be 1,600 psig at 73.4 degree F and 800 psig at 140 degree F per ASTM D 2387 and validated in accordance with Plastic Pipe Institute PPI TR-3. The pipe to have tensile strength at yield point per ASTM D 638 of a nominal molecular weight average of 300,000. Piping materials to be Plexco EHMW, Driscopipe 1000, or approved equal.

Miltred fittings to be fully pressure rated. A 90 degree elbow to have five segments and a 45 degree elbow to have 3 segments.